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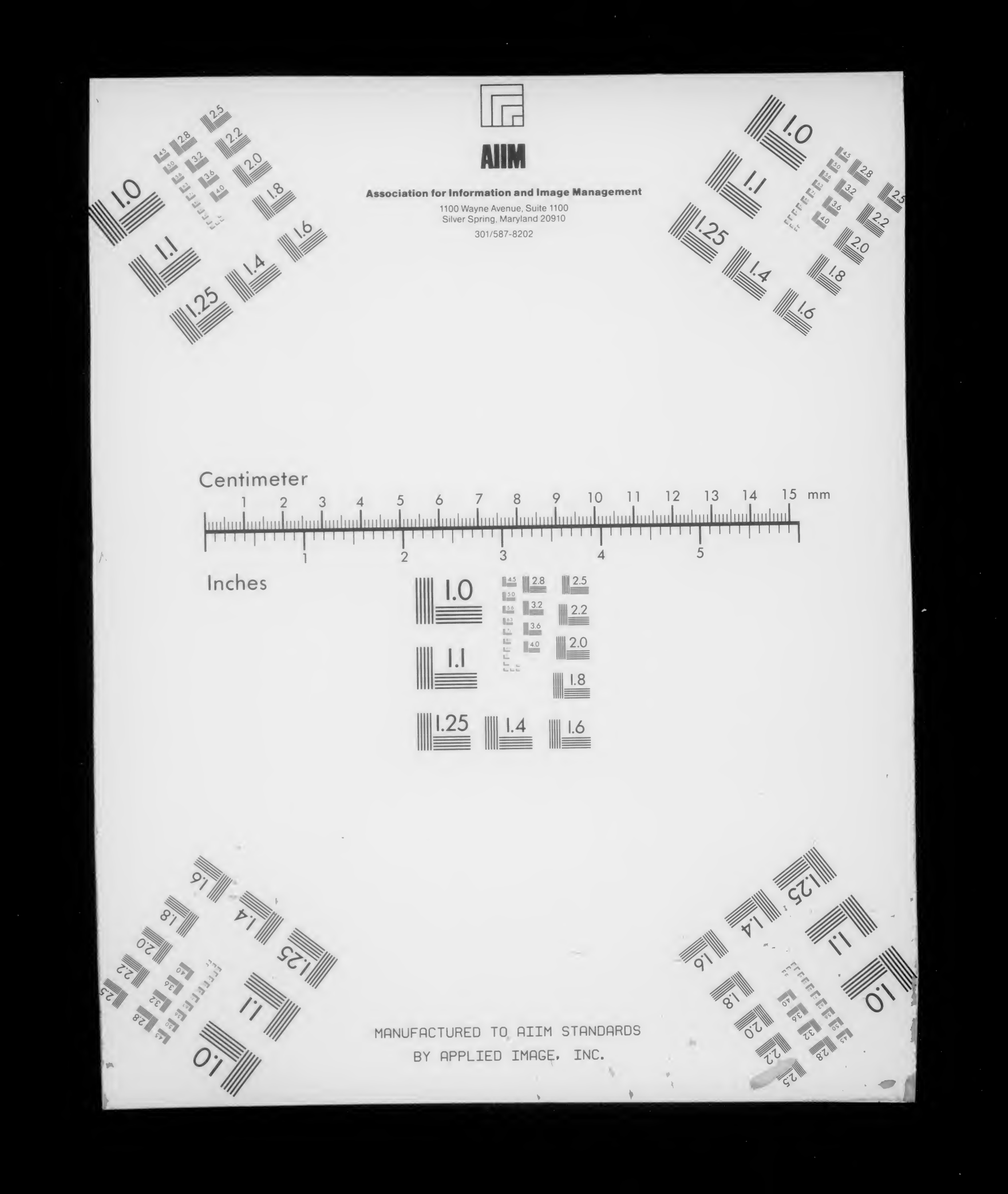
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A VINDICATION OF VIVISECTION

A COURSE OF LECTURES ON ANIMAL EXPERIMENTATION

BY MEN OF THE HIGHEST AUTHORITY IN THE MEDICAL AND OTHER PROFESSIONS

GIVEN UNDER THE AUSPICES OF THE GEORGETOWN UNIVERSITY SCHOOL OF MEDICINE IN GASTON HALL OF GEORGETOWN UNIVERSITY, MARCH 28 TO MAY 16, 1920

FRANCIS A. TONDORF, S. J., PH. D.

WASHINGTON, D. C.
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SECOND EDITION

Foreword to the Second Edition.

The first edition of this brochure has long since been exhausted. This second edition is the response to repeated requests for copies of these lectures. All papers appear in their original form except that of Dr. Simon Flexner, Director of the Rockefeller Institute for Medical Research. The additions in this paper strikingly point out the rôle of animal experimentation in the most recent triumph of medicine, namely, the treatment of diabetes with insulin. Another addition is a paper by Dr. John E. Lind, Senior Assistant Physician, Government Hospital for the Insane, Washington, D. C., and professor of Psychiatry and Neurology, Georgetown University, School of Medicine, entitled "Vivisection in the Study of Nervous and Mental Diseases."

Foreword to the First Edition.

To see life steadily and to see it whole is the serious duty of every true philosopher. And, after all, what is philosophy save unadulterated common sense amplified and systematized. Hence your real sensible man will approach the subject of animal experimentation dispassionately and weigh it in its proper relation to the good of the human race. Let him disregard these prime postulates of sound reason and he is headed straight for unbalanced sentimentality and irrational hysteria.

The stereotyped arguments advanced against the practice of animal experimentation are two, to wit, brutality and total lack of demonstrable and tangible results as might warrant the physical pain occasioned following the most clever scientifically regulated methods of vivisection. It is the modest purpose of this brochure to make available for the general public a discussion of such accusations and the pertinent responses made by experienced research workers in a series of public lectures given under the auspices of the Georgetown University School of Medicine in Gaston Hall of the Georgetown University from March 28 to May 16th of the year nineteen hundred and twenty.

To profit by the content of these pages the reader must divest himself of every prejudice or partisanship and focus his attention not on feeling but on the issue. He must recall that our cynophile friends are persistently dogmatizing that this is a moral question and then evaluate our ethical arguments against theirs. He must learn that their perverted commentary of the text which tells of the findings of medical researches envolving animal experimentation belies the original. He must read into this text the salus populi, the lex suprema. Then may we look for a fair judgment.

Francis A. Tondorf, S. J., Ph. D., Editor,
Head of the Department of Physiology.

Georgetown University School of Medicine.

A VINDICATION OF ANIMAL EXPERIMENTATION.

Based upon the work of the Rockefeller Institute for Medical Research in New York.

By

Simon Flexner, M. D., Sc. D., LL. D.

Note of the Editor.—The favor and enthusiasm with which the lectures of this symposium were generally received by our audiences have prompted us to extend them to a larger public. The introductory dissertation by Dr. Simon Flexner, head of the Rockefeller Institute for Medical Research of New York City, was not delivered from manuscript, and, unfortunately, no complete stenographic report was made. The Doctor left unexpectedly for Europe as American delegate to the International Convention of the Red Cross, and so even his notes were not available. This digest was assembled from notes as jotted down for their own use by University students in attendance upon the lecture, supplemented by references to Dr. Flexner's publications, and it is hoped represents the more noteworthy items. It is offered with every apology to Dr. Flexner.

The Lecturer after thanking the Rector of the University for his complimentary reference to the work in Preventive Medicine of the Rockefeller Institute for Medical Research, expressed satisfaction that the creation of an institution for the study of medical problems by a great and liberal philanthropist had placed him with his co-workers in a favorable position to accomplish something for the benefit of mankind.

The lecturer traced the development of medical science from its earliest inception, giving an account of the methods used by medical men to gain knowledge of diseases and graphically described the transition from an empirical to a rational basis. The result depending principally on our present-day knowledge of physics, biology and chemistry. He declared that at the present time the medical profession is better equipped to discharge its duties to mankind than ever before, a condition largely to be accredited to improved methods of attacking medical problems. The major portion of advances in scientific medicine having been accomplished within the past fifty years.

Dr. Flexner explained why the public should be informed as to the work and methods of scientific men in the medical profession, and explained the reasons for using animals to study disease. He contrasted the methods of clinical observation at the bedside of the patient with the present method of study by isolation of the causative organism, reproduction of the disease in animals and study of it there. He told of the relative progress of medicine in the last fifty years as compared with all preceding history. He declared that man's employment of his inalienable right to use the material things of the world was

responsible for the rapid strides in medicine, and pointed out that in the solution of a number of difficult problems the scientific medical investigation in the United States had made important and most creditable contributions.

Dr. Flexner expressed keen regret that an effort should be made in the Congress of the United States to prohibit experiments upon living dogs in the District of Columbia or the Territorial or insular possessions of the United States as contemplated by S. 1258, which bill, if enacted into a law, would be a serious blow to the progress of scientific medicine, as much of our physiological knowledge and the action of drugs is based upon experiments on dogs, and for some experiments no other animals can be substituted.

Dr. Flexner deprecated every effort to restrict this line of research work, in view of the fact that any reputable investigator takes *special* pains to prevent unnecessary suffering by the administration of anesthetics or opiates, and the prevention of cruelty in animals is especially well safeguarded by laws now in force in the District of Columbia. He referred to diabetes, a disease of considerable frequency, as illustrating the value of experiments on dogs in promoting knowledge of this important disease of man, and also in contributing to its better therapeutic control or treatment.

Diabetes.

In no department of human endeavor has a greater and more beneficent victory been attained than in respect to the control of that by no means infrequent disease known as diabetes. While records of the disease can be followed into the long and dim past, knowledge of its origin and precise nature is recent and has been secured wholly by means of animal experiment. And to animal experiment we owe the recent discovery of insulin, the employment of which in the treatment of diabetes is already so successful that the disease itself may be said to have lost its terrors.

Precise knowledge of the nature of diabetes dates from about 1890, at which time two German investigators discovered that the surgical removal of the pancreas invariably led to a fatal diabetes in animals. The pancreas was already known to consist of two parts: a glandular part pouring its secretion into the upper intestine in order to complete the digestion of the food, and another part, anatomically mingled with the former, the function of which could only be conjectured to be that of affecting the utilization of sugar by the body.

This latter it proved to be, and before long it could be shown that when these second structures—called after their discoverer islands of Langerhans—were diseased, diabetes resulted.

But no immediately practical benefit came from this demonstration. In the meantime, as dogs could be rendered diabetic by surgical

means, a way was opened to test the best means of prolonging the life of diabetic animals, and to experimental studies of this kind we owe the improvements in the dietetic control of diabetes in man made by Dr. Allen and others.

All this experimental work and the knowledge derived from it was to prepare the way for the discovery of insulin, the active secretion of the islands of Langerhans, by Banting nearly thirty years after the fundamental studies were made revealing the relation of the pancreas to diabetes.

There are in the United States alone in round numbers about 1,000,000 persons suffering from diabetes in mild or severe form. In other words, the disease attacks nearly 1 per cent of the population. Who can estimate the value of the hope and the restored happiness brought to these persons, their families and friends, by this beneficent discovery? As with all such advances, the fruits, the benefits, are permanent. Never again will diabetes haunt as of yore the imagination of man. His genius has brought the release, as it has brought other blessings, overcoming the effects of unopposed sinister natural forces. A few animals humanely experimented upon have freed civilized man in all countries and for all time from a frequent, mortal disease. Can anyone with reason and judgment question the purpose for which they were used?

Dr. Flexner stated that he had given a single concrete instance, but the instances could easily be multiplied, through which the beneficent use of the results of experiments on animals could be shown. He declared that by animal experimentation we have not only benefited man, but investigation into the disease of animals has led to the eradication of many of the diseases of animals with incalculable economic returns. Our knowledge of yellow fever would probably have been delayed for many years if the work of the Bureau of Animal Industry of the United States on Texas fever had not been done.

The Lecturer emphasized the important work done by the Federal Government for animal industry, all of which involved animal experimentation, and called attention to the Department of Animal Pathology of the Rockefeller Institute, established a few years ago on a farm of 400 or 500 acres, near Princeton, N. J., with laboratories, stables and other appurtenances, and a highly skilled scientific staff installed for the intensive study of diseases of animals themselves. Could the economic wastage caused by disorders of cattle, poultry, etc., be controlled or reduced, the cost of living, now such a matter of serious concern, would be materially diminished. In addition to diseases of economic animals we have, he said, a real interest in diseases of domestic animal pets, which are themselves the victims of many severe and fatal diseases, such as distemper among dogs. The study of this disease by the experimental method is not only indicated, but it is fair to say

that if we learn to control distemper, we should throw new light on the pneumonia problem; and he was tempted to add that had the lower animals the power of voice, they might well ask to be saved from those who appear to be their friends.

Contrasting the ancient use of drugs with the manner in which they are employed at the present time he showed how their specific action has been determined by the employment of animals for experimental study.

Beginning with a tribute to the pioneer work of Pasteur, Koch and other pioneer-research workers, the lecturer traced the various steps in the development of the great branch of bacteriology that embraces all that we know of the cause, the prevention and treatment of all infectious diseases, including serums and vaccines, and ends at the present time with the researches by Noguchi on the organism of yellow fever. As an instance of the curative powers of antitoxins he cited the vast reduction in mortality following the employment of diphtheria antitoxin, which is now less than one quarter of the death rate before the introduction of the antitoxin.

Cerebro-Spinal Meningitis.

Dr. Flexner said he had been asked to say a few words about the benefits of animal experimentation in relation to epidemic cerebro-spinal meningitis. This disease, also known as cerebro-spinal fever and spotted fever, was described as early as 1805 and has appeared in epidemic form at various intervals in Europe, in the United States and other parts of the globe. Hirsch distributes the epidemic occurrence of this disease through four periods, namely, 1805-1830, 1837-1850, 1854-1875, 1876 to date. In the first period it appeared in isolated epidemics in Europe and to a much greater extent in the United States. After its primary appearance in Massachusetts in 1806, according to some epidemologists, it continued throughout New England in various localities for the next ten years. During the second period widespread epidemics occurred in France, Italy, Algeria, Denmark and the United States; during the third period it prevailed in Europe, Asia, Africa, South America and the United States. During the last period it has been specially marked in Germany, Italy and the United States. The disease prevailed in an epidemic form in 1904 and continued to be more or less active until 1910; since then, although less active, it has not entirely disappeared and became again active during the recent war.

The organism causing this disease, thanks to animal experimentation, had been isolated and described by Weischselbaum in 1887 under the name of *diplococcus intracellularis meningitidis* and although perfectly familiar with the cause and nature of the disease, the medical profession was helpless in the way of treating this acute infectious disease quite fatal in its tendency.

Dr. Flexner in 1904 during the epidemic along the Atlantic seaboard and from there inland, studied the disease at the Rockefeller Institute and proved by inoculation experiments that it was communicable to animals. This was an enormous step forward, for it gave him a basis for the hope of being able to treat the disease successfully by means of immunized serum. The work was done on monkeys, and subsequent experimentation proved that not only could the disease be reproduced in these animals, but also successfully treated with immune serum. Later this treatment was and is now being used in the treatment of cerebro-spinal meningitis in man. Dr. Flexner said that 25 monkeys had been used in this work. (It has been estimated by Professor Welch and other competent critics that before this method of serum treatment was employed, out of every one hundred patients seventy-five died, while under the serum treatment the mortality has been reduced from seventy-five to twenty-five per cent. It is not generally known that this demonstration based upon animal experimentation is regarded as one of the most important contributions ever made to scientific medicine and has secured for Dr. Flexner, the Rockefeller Institute and American medicine a place of honor in the medical world. —Editor.)

Poliomyelitis.

Dr. Flexner recalled the work of the Rockefeller Institute with reference to the etiology and pathology of poliomyelitis, popularly known as infantile paralysis, and explained how they had been able to transmit the disease from monkey to monkey through the secretions of the nasal-pharyngeal mucous membrane and thus secured important information as to the mode of transmitting the disease. He said in part: In the United States we are becoming increasingly familiar with epidemics of poliomyelitis. Prior to 1907 infantile paralysis was a rare disease in this country; since then it has prevailed fitfully every summer and autumn, and in one notable instance at least also in the winter season, claiming victims by the score or hundred, until in 1916 an outbreak of unprecedented severity, with its center of violence in New York State, swept over a considerable number of States. Our knowledge of poliomyelitis has grown since Wickman's epochal clinical studies published in 1907. Thanks to animal experimentation we are in possession of precise information covering essential data with regard to the nature of the inciting microörganism, notwithstanding its very minute size, and also concerning the manner in which it leaves the infected or contaminated body within the secretions of the nasopharynx chiefly, and gain access to another human being by means of the corresponding mucous membranes and apparently in no other way. Moreover, the inciting virus, so called, up to the present time and notwithstanding many and assiduous efforts, has not been detected apart from

the infected or merely contaminated human being, and there is therefore no foundation in ascertained fact for an assumption that the virus is conveyed to persons otherwise than by other persons who harbor it.

Control of Yellow Fever Epidemics.

As an example of the manner in which an epidemic disease may be eradicated he briefly related the history of the conquest of yellow fever and expressed his satisfaction that the causal organism had been discovered before the complete disappearance of the scourge. If so, it will be the first disease to so disappear since recorded history.

We no longer fear yellow fever in New York, Philadelphia and other Northern districts of the United States in which formerly it was a serious pest, claiming victims by the thousands. We are now sufficiently informed of the conditions of its origin and spread to maintain effective safeguards. The everthreatening hotbeds of yellow fever at Havana and in Brazil are now under control, and can be kept so if we do not relax our vigilance.

Prior to the beginning of the present century yellow fever was a peril because no one knew the exact conditions favoring its spread. In 1900 a commission of officers from the United States Army, headed by Dr. Walter Reed, with Drs. James Carroll, Jesse W. Lazear and Aristides Agramonte went to Havana where the fever flourished, and made a series of studies and came to the conclusion that there must be a living organism in the blood of yellow-fever patients in the early days of the disease. They found that a mosquito could act as intermediary in conveying the disease. They did not spare themselves, and following the bite of a purposely infected mosquito, Carroll became ill of yellow fever, while Lazear died after a short illness. Reed died in 1902, and his memory lives in the great Walter Reed Hospital at Washington. From this knowledge of the mosquito as a carrier of yellow fever it became clear that the way to prevent the spread of the disease was either by keeping the mosquito from patients in the early stages of their illness through proper screening of windows and doors, or by killing and destroying their breeding places. All these measures were applied in Havana by General Gorgas. They have since been practiced in New Orleans, Vera Cruz and Rio de Janeiro.

In the Southern States, however, while the old, aimless and largely futile struggles against the disease when once it had gained a foothold can never come again, there is always the liability of costly and increasing local outbreaks so long as permanent nests of the disease exist in countries with which direct social or economic intercourse is maintained. The everthreatening hotbeds of yellow fever at Havana and in Brazil are now in control and can be kept so at the price of intelligent and unremitting vigilance. But here and there in Mexico and South

America and on the west coast of Africa it still lurks unguarded. It is the aim of the International Health Board of the Rockefeller Foundation to discover and clean up the remaining lurking places for germs of this disease, along the lines already inaugurated in the fight against hookworm and the eradication of malaria in different parts of the globe. At the request about a year and a half ago from Ecuador for counsel and assistance in solving the problems of yellow fever at Guayaquil, the Rockefeller Foundation and the Rockefeller Institute cheerfully sent General Gorgas and his associates of the International Health Board to study conditions in that country. The Commission was accompanied by Dr. Hideyo Noguchi, the accomplished Japanese bacteriologist, on the staff of the Rockefeller Institute for Medical Research. Dr. Noguchi apart from his command of cultural technique and great patience was also well acquainted with a disease called infectious jaundice, which resembles yellow fever. It is one of the diseases whose origin has only recently been traced. The inciting germ, called *Leptospira*, is a spiral motile organism, parasitic in rats and other animals. In insanitary places frequented by these animals it may gain access to the bodies of humans and incite serious and fatal disease. Noguchi succeeded in inducing in guinea pigs by transference of a small quantity of the blood of yellow-fever patients, symptoms comparable with yellow fever in the human race. The blood of these experimental animals, when conveyed to other guinea pigs, produced the same disease, and in this infected guinea pig blood, a minute organism resembling the *Leptospira* of infectious jaundice was detected. Young dogs and monkeys were also found to be susceptible to inoculation with yellow fever blood.

Noguchi also succeeded in cultivating from the blood at first of his artificially infected pigs and then of man a living organism which he carried through many successive generations in his culture tubes, and from which by inocuation he could induce the identical fatal disease in the guinea pig. Noguchi called this germ *"Leptospira icteroides."* Work is now being carried on by animal experimentation for the solution of unsolved problems, including the perfection of a suitable serum for this disease. It is hoped this work will be entirely successful and prove a blessing to mankind.

Control and Management of Other Epidemic Diseases.

On this important topic Dr. Flexner reviewed our knowledge of epidemic diseases and the practical hygienic measures, based on this knowledge, which have heretofore been applied, or which in the ordinary course of events may be applied with a reasonable hope of preventing the spread of these epidemics. The Lecturer expressed the hope that by a careful review of what has been accomplished in the past we may form a judgment of the efficiency of such measures and

arrive possibly at new points of view from which to launch a more decisive attack. (Dr. Flexner is evidently a stanch advocate of the doctrine that disease germs have their origin somewhere, and scientific medicine demands that all epidemics must be traced backward to their starting point, and when found the original seedbeds must be stamped out. In support of this doctrine, which is now practically applied by the International Health Board of the Rockefeller Foundation, he spoke in part as follows:—Editor.)

Regarding epidemic diseases in general we assume the introduction from without, and usually from a distant locality of a special kind of organism which is held directly responsible for the epidemic ensuing. In the case of influenza wide divergences of opinion regarding the nature of the inciting microörganisms and the manner of infection still prevail. The reason for these differences are several, but the most important perhaps relates to the common observation of the manner of spread or attack of the disease. While other epidemics proceed from bad to worse, with at least progressive increases of intensity, influenza seems to overwhelm communities over even wide stretches of territory as by a single stupendous blow. While in the one case the gradually accelerating rate of speed of extension may be taken to indicate personal conveyance of the provoking microörganism; in the other case, the sudden wide onset appears to be the very negation of personal communication.

Hence the invoking of mysterious influences, the revival of the notion of miasm and similar agencies, to account for this phenomenon. Indeed, the public mind in general lends itself readily to such formless concepts, for the reason that there still resides in the mass of the people a large uneradicated residue of superstition regarding disease. One does not need to look far or to dig deep to uncover the source of this superstition. We have only recently emerged from a past in which knowledge of the origin of disease was scant, and such views as were commonly held and exploited were mostly fallacious. It is, indeed, very recently, if the transformation can be said to be perfect even now, that the medical profession as a whole has been completely emancipated. All this is very far from being a matter of remote importance only, since in the end the successful imposition of sanitary regulations involves wide coöperation, and until the majority of individuals composing a community is brought to a fair level of understanding of and belief in the measures proposed, serious and sustained endeavor to enforce them is scarcely to be expected.

Influenza.

No better instance of a communicable disease could perhaps be invoked than influenza to exorcise the false idea of the mysterious origin of epidemics. To dwell solely on the sudden and overwhelming

stroke of the disease is to wholly overlook the significant incidents that precede the mass infection, because they are of such ordinary nature and lack the dramatic quality. Accurate observers noted long ago that influenza in its epidemic form did not constitute an exception to the common rule regarding epidemic diseases, which are obviously associated with persons and their migrations. What the early students made out by tracing the epidemic backward to its point of departure more modern observers have confirmed by carefully kept records, often geographically compiled, as in the excellent instance of the Munich records covering the epidemic of 1889-92, which can now be supplemented by a number of similarly constructed records of the epidemic just passed. These records show convincingly a period of invasion during which there is a gradual rise in the number of cases to culminate, within a period variously estimated at from one to three weeks, in a widespread, so-called "explosive" outbreak of the disease. It happens that the early cases of influenza tend not to be severe, chiefly because they are rarely attended by pneumonia and hence are frequently mistaken, and the confusion in diagnosis is resolved only when the full intensity of the epidemic is realized. In the meantime rich opportunity has been afforded for the free and unrestricted commingling of the sick and well, of doubtless healthy carriers of the inciting agent and others, until so high a degree of dissemination of the provoking microörganism has been secured as to expose the entire susceptible element of the population, which happens to be large, to an almost simultaneous response to the effects of the infecting microbe.

Deductions of like import can be drawn from the geographical movements of an influenza epidemic. In Eastern Russia and Turkestan influenza spreads with the pace of a caravan, in Europe and America with the speed of an express train, in the world at large with the rapidity of an ocean liner; if one project forward the outcome of the means of intercommunication of the near future, we may predict that the next pandemic, should one arise, will extend with the velocity of an airship.

It is desirable, in the interest of clear thinking, to carry this consideration of the characteristics of epidemic influenza a step further. A feature of the epidemic disease of particular significance is the tendency to recur; that is, to return to a stricken region after an interval, usually of months, of relative quiescence. Thus the beginnings of the last pandemic in Western Europe and the United States have been traced to sporadic cases appearing in April, May and June, possibly even earlier in certain places, while the destructive epidemic raged during September, October and November of 1918. The disease also prevailed, more or less, in the United States during 1919 and again during the present year. The epidemic of 1918-19 cost more in a few months in human lives than were killed during the five years

duration of the great war. The statistics from India alone show something like 6,000,000 deaths. In this country the estimates so far have varied from 600,000 to 800,000, and you can carry that proportion around the world.

There are very good reasons for believing that influenza is not in itself a serious disease, but that its sinister character is given by the remarkable frequency with which it is followed in particular instances by a concomitant or secondary pneumonic infection, to which the severe effects and high mortality are traceable. Now, it is this high incidence of pneumonia, the product of invasion of the respiratory organs with bacteria commonly present on the upper respiratory mucous membranes—streptococci, pneumococci, staphylococci, Pfeiffer's bacilli, and even meningococci—that stamp the recurrent waves of the epidemic with its bad name.

If we compare the pneumonic complications of influenza with those that arose in the cantonments in 1917-18, first as attendants of measles and later as an independent infection, we note immediately that in both instances the severe effects and high fatalities arose, not from bacteria brought or imposed from without, but from their representatives which are commonly resident upon the membranes of the nose and throat in health. Whatever we may have to learn of the microörganisms inducing measles, still undiscovered, and of influenza, still under dispute, and their mode of invasion in the body, no one would question that the bacteria inducing pneumonia are personally borne.

Renewed study by the experimental method of the successive epidemic waves of influenza since 1919, has yielded to Doctors Olitsky and Gates of the Rockefeller Institute a minute bacterium which fulfills many, if not all the requirements of the microbic inciting agent of influenza. Should present hopes and expectations in this regard be fulfilled, we shall look forward more confidently to a measure of control, should another epidemic arise, than in the case of past epidemics.

Streptococcus Pneumonia.

In discussing this subject the lecturer pointed out that during the winter of 1917-18 there occurred in several localities within the United States, and also, but in a less degree, in France, at least a great increase in the incidence of a type of pneumonia which previously had been very infrequent. It appears also that the greatest number of cases and of fatalities arose in the United States in the military cantonments; that the disease first prevailed, as already stated, as secondary pneumonia following measles; but before long the severity of the infection was such that cases of primary streptococcus pneumonia began to arise. Moreover, at this juncture the disease spread from the military to the civil populations. The nature of the microörganism inducing this form

of epidemic pneumonia is indicated in the name which the disease has come to bear. The difficulty in this instance has not been in finding out the inciting microbe, but, rather, in differentiating the streptococci responsible for the epidemic disease from streptococci possessing the ordinary pathogenic properties or even from those of saprophytic nature so commonly present on the upper respiratory mucous membranes without provoking widespread disease. However, numerous studies of the bacteriology of this epidemic of pneumonia, at distinct and often widely remote cantonments, involving much animal experimentation, showed that the microbic incitant was in almost every instance *streptococcus hemolyticus*. Moreover, because of the wide occurrence of the epidemic pneumonia, this type of streptococcus could be found in normal throats and as a secondary invading microörganism in the lungs in cases of ordinary lobar pneumonia. Thus far very little progress has been made in the classification of streptococci, which from a class apparently even more heterogenous than the pneumococci and will involve much arduous experimental laboratory work.

With these various considerations before us we may now discuss the question of the efficiency of our public-health measure in diminishing the incidence of epidemic diseases. It is evident that in diseases in which the inciting microörganism enters the body by way of the air passages, although not necessarily, as in poliomyelitis, directly injuring those parts, protection is not to be secured by applying sanitary measures on a wide scale to an extraneous and inanimate source by which the inciting microörganism enters the body by way of the air dejecta of typhoid patients, or even to inferior animal species such as the mosquito or the rat, which act as intermediaries in conveying the germs of yellow fever or of infectious jaundice; but it is alone to be attained by methods of personal hygiene, applied on the individual scale of safeguarding one person from another, the most difficult of all hygienic regulations to enforce.

As a result of animal experimentation in epidemic poliomyelitis we may fairly claim that we are in possession of the essential facts which, if widely applicable, should enable us to control the spread of that disease.

Epidemic diseases in the commonly accepted sense have fixed locations—the so-called epidemic homes of the diseases. In those homes they survive without usually attracting special attention often over long periods of time. But from time to time, and for reasons not entirely clear, these dormant foci of the epidemics take on an unwonted activity, the evidence of which is the more frequent appearance of cases of the particular disease among the native population, and sooner or later an extension of the disease beyond its endemic confines. Thus there are excellent reasons for believing that an endemic focus of poliomyelitis has been established in Northwestern Europe from which the recent epidemic waves have emanated.

Similarly there are excellent reasons for regarding the endemic home of influenza to be Eastern Europe, and in particular the border region between Russia and Turkestan. Many recorded epidemics have been shown more or less clearly to emanate from that area, while the epidemics of recent history have been traced there with a high degree of conclusiveness. From this eastern home, at intervals of two or three decades, a migrating epidemic influenza begins, moving eastward and westward, with the greater velocity in the latter direction.

Now, since the combatting of these two epidemic diseases, when they become widely and severely pandemical, is attended with such very great difficulty and is of such dubious success, and this notwithstanding the prodigious public-health contests which are waged against them in which the advantages are all in favor of the invading microorganismal hosts, it would seem as if an effort of central rather than peripheral control might be worth discussion. According to this proposal an effort at control amounting even to eventual eradication of the diseases in the regions of their endemic survival should be undertaken, an effort, indeed, not occasional and intensively spasmodic, as during the pandemical excursions, but continuous over relatively long periods, in the hope that the seed beds, as it were, of the diseases might be destroyed.

That such an effort at the eradication of a serious epidemic disease may be carried through successfully the experience with yellow fever abundantly proves. In attacking the disease the combat was not put off until its epidemic spread had begun and until new territory, such as New Orleans, Jacksonville, Memphis, etc., had been invaded; but the attack was made on its sources at Havana, Panama, and now Guayaquil, to which endemic points the extension into new and neutral territory had been traced. Such a plan is now in process of elaboration by the Rockefeller Institute.

Encephalitis Lethargica.

Another disease that demands animal experimentation and intensive study is lethargic encephalitis, apparently only recently introduced in, and already widely distributed through, this country. It is highly desirable that the main facts known should be given publicity; and it may be well that the experience, gained with poliomyelitis, may serve us in dealing more effectively with the encephalitis peril.

It appears that the first cases of that disease recognized in the United States occurred in the winter of 1918-19. In contradistinction to epidemic poliomyelitis, there is no reason to suppose that this epidemic affection of the central nervous system ever before existed in America. The point is an important one. At present the disease seems to be widely distributed, as cases have been reported from many States.

It is possible to trace the cases of lethargic, or epidemic encephalitis, now arising in this country, to an outbreak which occurred in Vienna and neighboring parts of Austria in the winter of 1916. Because of war conditions, knowledge of this unusual disease did not at once reach Western Europe and the United States; but nevertheless cases of the disease occurred in England and France in the early months of 1918, and in America about one year later. Both in Austria and in England, in which countries the first cases were observed, respectively, in eastern and western Europe the disease was first mistakenly attributed to food intoxications. In Austria the early cases were ascribed to sausage poisoning; in England to botulism arising from various foods. This error is not perhaps as remarkable as might at first appear. In the first place, both countries were laboring under unprecedented conditions of food shortage, preserved foods were employed on a scale never before equaled, and, of course, waste and refuse were reduced to a minimum. Furthermore, an early symptom of this encephalitis is third-nerve paralysis—giving rise to diplopia, ptosis, etc.—which happens also to be an early symptom in certain forms of food poisoning and notable in botulism. Ultimately, in both countries the notion of food origin became untenable, and the disease was recognized as arising independently of diet and other usual conditions of life, and came to be viewed as probably of microbic origin and of communicable nature.

It is now sufficiently obvious why the popular name of "sleeping sickness" has been applied to this malady. The disease is, of course, wholly distinct from African sleeping sickness, which is a trypanosomal infection carried from person to person by means of an insect vector—the tsetse fly. When an apparently new disease arises, it is always important to inquire whether the particular set of symptoms that are taken to characterize it has been observed and recorded before.

In the present instance there are significant records which may easily refer to a similar and possibly identical disease. The first one dates from 1712 and refers to an outbreak of so-called sleeping sickness centering about Tubingen in Germany. The second record dates from 1890 and deals with a puzzling malady called nona, which is described rather in the lay than the medical literature of the time and seems to have prevailed in the territory bounded by Austria, Italy and Switzerland. In respect to neither instance, however, do the records contain the minuter data which would admit of a certain identification of the disease described with the encephalic malady we are considering. One circumstance is, however, significantly suggestive. The location of the 1890 affection "nona," which was characterized by somnolence, stupor and coma, coincides roughly at least with that of the first cases reported in the present epidemic. The question may, therefore, well be raised whether the endemic home of this epidemic

variety of encephalitis may not be that corner of southeastern Europe overlapping the three countries mentioned. If this should prove to be probable, the next question to arise would relate to the circumstances under which the disease slumbered on in ordinary times, and to the conditions that favored a greater activity and a wider spread about the year 1916.

To deal with the first one will require particular and intensive studies carried out with the especial object in view to disclose hidden cases in the region originally affected. An answer can in the meantime be hazarded to the second question. The depressing effects of war, acting by way of hunger, cold, migrations of populations and general insanitation, might initiate the conditions through which a low endemic might well be converted into a higher epidemic incidence of the disease.

It is now a matter of great importance to determine the precise nature or etiology of lethargic encephalitis. Many unsuccessful attempts have been made to communicate the disease to monkeys and other animals through the inoculation of nervous tissues showing the particular lesions in the manner so readily and successfully employed in monkeys for poliomyelitis. This circumstance alone would serve to distinguish this epidemic encephalitis from epidemic poliomyelitis. But in two or three instances, what are stated to be successful transmissions of the disease to animals have been reported.

It is still too soon to say whether in the beginning made in conveying from human cases of encephalitis to rabbits an inflammation of the brain (encephalitis), we have already secured the counterpart of lethargic encephalitis in man. There are both similarities and disparities involved, which future studies alone can explain and reconcile. But an important step forward with this puzzling and sinister disease has been taken by means of the experimental method, and wider and practically useful knowledge is to be awaited with confidence. But at this moment, and while waiting for the ultimate and convincing experimental results, one need entertain no doubt of the infectious and communicable nature of lethargic encephalitis.

In conclusion Dr. Flexner remarked that time would not permit him to discuss many of the problems now awaiting solution or to refer to the work carried on by the staff of the Rockefeller Institute for Medical Research in all of its departments, but expressed the fervent hope that in the interests of the human race and the animals themselves, the progress of scientific medicine would not be impeded by unnecessary legislation.

THE LEGAL ASPECTS OF VIVISECTION.

By

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After the exposition that has just been made of the inestimable benefits in the interest of human health and happiness that have been achieved through animal experimentation, and that would have been impossible without it, no one of you can fail to see the danger inherent in any attempt to restrict that field of research or to hamper operations within it. Certainly any needless restriction and hindrance would be hardly short of criminal, and the burden of showing the necessity for any such restriction or hindrance as may be proposed rests clearly upon the proponents.

In the absence of clear evidence of a wrong to be righted, no legislation to restrict and hinder animal experimentation is justifiable; and if wrong be shown, then such remedial legislation as may be proposed should have some direct and demonstrable relation to the end to be accomplished and should go no further than is necessary to accomplish that end. Let us see what the facts are with respect to the legislation now pending in Congress to prohibit absolutely and forever, in the District of Columbia and in the Territorial and insular possessions of the United States, all experiments upon living dogs, unless the experiment has for its sole purpose the healing or curing of some physical ailment of the very dog experimented upon.*a*

The alleged motive of the proposed legislation is set forth in the preamble of the bill; the enactment of such legislation is, "an act of right and justice to the dog," because "the dog has made a wonderful war record," and "because he has been decorated for bravery, serving his country, following its flag, and dying for its cause." But some doubt seems to be thrown, I am sorry to say, on the sincerity of this preamble by a statement made by one of the leading proponents of the bill, to the effect that "We are so modest that we are beginning with the

a A bill to prohibit experiments upon living dogs in the District of Columbia or in any of the Territorial or insular possessions of the United States, and providing a penalty for violation thereof. S. 1258, 66th Congress, 1st session.

thin edge of the wedge. We want to save dogs, and later on we will probably try to save other animals." *b* If dogkind is now to be honored in the manner proposed in this bill, because of the distinguished services rendered by dogs during the war, it is not quite clear why similar honor should be bestowed upon other species that did not render such service; such a course would certainly cheapen the honor bestowed on the dog! And if other species did render such distinguished war service, it would seem as though they, equally with the dog, should be honored now in the pending legislation rather than asked to wait for their honors. The horse and the mule, that did such noble work in transportation; the carrier pigeon, that did such remarkable messenger service; the steer, the sheep, the hog, the chicken, and even the fish that gave up their lives that the army and the people might live; maybe even the cat, who did her bit in the protection of food supplies from rodent depredations; and most assuredly, the modest guinea pig, that endured so much in testing and standardization of medical supplies —certainly the righteous claims of all of these cannot justly be ignored and lightly brushed aside if the real purpose of this bill is to grant in perpetuity as a reward for war service freedom from all experimentation.

Waving, however, possible question as to the motive of this bill and proceeding to a study of its text and of the hearing on it, we fail to discover any evidence of "the wonderful war record" of the dog notwithstanding the fact that that record would seem from the preamble to form the very heart of the demand that all dogkind be relieved for all time of its obligation to repay to man in some small degree the affection, care, and effort that man has bestowed upon him, and of the demand implied in it, to transfer to other species the burden that the dog might equitably be expected to share with them, of submitting to experimentation in the interest of mankind and of animals generally. That some dogs manifested faithfulness and courage during the war (to the extent that such virtues can be translated from mankind to the brute creation), no one will deny; but that all dogs tried out in war service distinguished themselves by such conduct has never, so far as I am informed, been asserted, nor even that faithfulness and courage were distinguishing characteristics of most of them.

And yet this bill proposes to do homage to all dogs alike; not merely to the faithful, but also to the traitor; not merely to the courageous, but also to the cowardly; not merely to the dog that saw war service, but also to the pampered pet in the fashionable, steam-heated apartment house or palace, that lived on the fat of the land, and occupied the time of his mistress and maybe a nurse maid or two, that had better been devoted to the welfare of the men in the trenches; and that the honors may be entirely even, they extend even to the sheep-killing mongrel that did his best to keep down the meat supply and the wool supply of the country during war time. Finally, as if the present generation of dogs were not numerous enough, and big enough, and strong enough to carry the honors that the proponents of this bill would heap upon the species, it is proposed that such honors be spread over generations of dogs as yet unborn, from now on henceforth forevermore. Certainly, if the attribute of courage can rightly be attributed to dogkind, no self-respecting dog that did its bit during the war would ask for his offspring forever that it be exempted from all liability to one of the most important services it can render mankind—and brutekind, too, for that matter; for experiments on dogs contribute to the well being not only of human beings but of domestic animals as well, including dogs themselves.

Even if we were to agree with the proponents of the legislation now under consideration, that for the reasons stated in the preamble honor should be conferred upon dogkind, there would still lie before us a wide field for discussion and debate as to just what honor and how much honor should be conferred. Discussion and debate of this kind would, however, take us so far afield as to render impossible any profitable result within the time at our command, and the proponents of this legislation, by naming in it a single and very definite form of honor, have virtually limited discussion to that form. After the enactment of the proposed legislation it is to be unlawful in the District of Columbia or in any of the Territorial or insular possessions of the United States "for any person to experiment or operate in any manner whatsoever, upon any living dog, for any purpose other than the healing or curing of said dog of physical ailments"; and the bill is entitled " A bill to prohibit experiments upon living dogs in the District of Columbia or in any of the Territorial or insular possessions of the United States, and providing a penalty for violation thereof." To be sure of our ground, it may be well to make certain just what an "experiment" is, and the Standard Dictionary is probably a safe guide upon this point. To experiment is, according to the Standard Dictionary, to make an experiment, test, or trial; to submit a thing or person to any process or ordeal, as for purpose of investigation or discovery. And an experiment is an act or operation to discover, test, or illustrate some truth, principle, or effect.

Manifestly, then, the enactment of the proposed legislation would make unlawful any test or trial upon any living dog for any purpose whatsoever, other than the healing or curing of said dog of some

b Hearing before the subcommittee of the Committee on the Judiciary, United States Senate, 66th Congress, 1st session, on S. 1258 page 25.

physical ailment. A dog without a physical ailment could not be subjected to any experiment, test, or trial, of any kind. A dog suffering from a physical ailment could be subjected only to an experiment, test, or trial that was designed to remove that particular ailment from that particular dog. Whether the experiment, test, or trial was calculated to add to the dog's comfort, to give it pain, or to give it pleasure would be utterly immaterial for the purpose of determining whether the experiment was or was not punishable under the law. Probably, however, we can for present purposes ignore the proposed prohibition of comfort-giving and pleasurable experiments, tests, and trials, which maybe the proponents of this bill did not really intend to prohibit—although it would have been much better for them to have expressed their ideas more clearly if that is the case; and we can limit our consideration of the matter to the general class of experiments that cause varying amounts of inconvenience and possibly even some pain to the dog experimented upon, varying from the prick of a hypodermic needle to the pain that may be suffered after recovering from the anesthetic administered during some more or less serious and important experiment, made in the interest of humanity or of animal kind generally. Is there, or is there not, need for any legislation to prevent the infliction of such pain and inconvenience upon dogs in the District of Columbia and in the Territorial and insular possessions of the United States?

Within the time at my command, I have not had the opportunity of examining the laws in force in the various Territorial and insular possessions of the United States relating to the infliction of pain and discomfort on animals. If such laws are adequate there is no need for further legislation; and the burden of proving inadequacy rests upon the proponents of the legislation now before us. If the legislative bodies of those several jurisdictions have fallen short of their duty, evidence of that fact should be produced before Congress is asked to assert its jurisdiction in the premises. And I may add incidentally, the record shows no demand for this proposed legislation from the people of the Territories and the insular possessions—nor from the people of the District of Columbia either, for that matter. The pressure for its enactment seems to come largely from persons residing in jurisdictions that cannot be affected by it, and in these jurisdictions they have not succeeded, and possibly have not even tried, in procuring the enactment of such legislation as they now suggest be imposed on communities to which they are in large part strangers.

That so far as the District of Columbia is concerned there are laws for the punishment of persons guilty of cruelty to animals is too well known to need comment. Prosecutions are being brought continually under such laws. There is, however, in the law, as in common speech, a distinction between cruelty and the mere imposition of discomfort or pain. The imposition of discomfort or pain constitutes cruelty and is punishable only when it is not inflicted for a justifiable

end. The determination of the matter now before us, in so far as the adequacy of existing law in the District of Columbia is concerned hinges, then, on the question whether the ends sought by experimentation on dogs are justifiable ends, and whether in connection with such experiments, if the ends sought are justifiable, such pain as is inflicted is or is not a necessary element of the experiment. If, all things considered, the ends sought by such experiments are justifiable, then clearly the experiments should not be prohibited; and if pain is a necessary element in such experiments, then to prohibit pain is to prohibit the experiments. A brief examination of the law in force in the District shows that all of these considerations have passed in careful review before the legislative authorities of the District of Columbia and that they have been wisely acted upon. Public morals have been duly safeguarded, the humane treatment of animals definitely insisted upon, the rights and opportunities of investigators reasonably safeguarded, and extraordinary provisions made for the enforcement of the law.

The law governing experimentation upon animals in the District of Columbia was enacted by the Legislative Assembly in 1871 and is set out at length in Albert's Statutes in Force in the District of Columbia, pages 540 *et seq.*a It makes it unlawful to inflict unnecessary cruelty upon any animal or to authorize or permit any unnecessary torture, suffering, or cruelty of any kind. And if there were any doubt as to whether the provisions of this law were or were not applicable to cases in which pain might be inflicted in connection with animal experimentation, it would be very definitely dispelled by the following provision:

"Section 15. Nothing in this act contained shall be construed to prohibit or interfere with any properly conducted scientific experiments or investigations, which experiments shall be performed only under the authority of the faculty of some regularly incorporated medical college, university or scientific society."

Stated in other words, no infliction of pain is to be tolerated unless the experiment is of a scientific nature and properly conducted; and in order that there may be some assurance that such experiments as are performed are presumptively of this character, they may lawfully be performed only under the authority of some competent, responsible organization, which in effect stands back of the experiment either by authorizing the particular experiment that is to be made or else by vouching, as it were, for the judgment and qualifications of the experimenter to engage generally in that field of work.

But in order to guard against the possible incompetence or carelessness of experimenters, medical colleges, universities, and scientific societies with respect to this matter, it is made the express duty of all

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a For the pertinent parts of this Statute see Appendix.

police officers and of any member of the Washington Humane Society to prosecute all violations of the act that come to their notice or knowledge. And if any member of the Washington Humane Society believes and has reasonable cause to believe that the laws in relation to cruelty to animals have been or are being violated in any particular building or place, he is upon oath or affirmation to that effect, and due application, entitled to a search warrant. And as though to insure beyond the peradventure of a doubt that the provisions of the law would be carried out, it is provided that fines and forfeitures collected upon or resulting from the complaint or information of any member of the Washington Humane Society shall inure to and be paid over to that society.

On the face of things, the law as set forth above certainly seems ample to prevent cruelty to animals, including within the meaning of the word cruelty all such pain as may be inflicted in connection with unnecessary experimentation and all such as may be needlessly inflicted in connection with experimentation that is in itself necessary and proper. Dogs and all other animals seem to be amply protected. And when it is remembered that this law has been in effect for almost half a century it seems certain that if there has been any unnecessary infliction of pain in connection with experimentation on animals there must be within that half century some record of prosecutions which, if the law be effective, must have resulted in convictions and punishments and, if the law be ineffective, must have left upon the records of the courts of the District of Columbia evidence of that fact.

I had occasion in the year 1900 to look carefully into this matter, the law having been then in force for more than a quarter of a century, and I was then unable to find any evidence of a single prosecution having been brought, either upon the initiative of any private citizen, or of any police officer, or of any member of the Washington Humane Society. No record could be found of a single search warrant having been applied for under the act or of any effort ever having been made to institute any prosecutions under it. It follows, of course, that there was no record of any court ever having construed this law as inapplicable to cases involving the infliction of unnecessary cruelty in connection with animal experimentation. All of these facts were made public at the time, and certainly should have served to stimulate the issue of search warrants and to stimulate prosecutions, if reasonable suspicion or concrete evidence of violations of the law were at hand. Ever since this situation was made public, the year 1900, I have been intimately in touch with the situation, and during all that time I have known of no effort to obtain a search warrant under the law, of no attempted prosecution under it, and, of course, of no court decision indicating the ineffectiveness of the law to accomplish its manifest purpose. It seems safe to say, therefore, that there is in the District of Columbia no experimentation upon dogs or other animals that is not

regulated by existing law, duly safeguarded by the watchful and special authority of the Washington Humane Society itself.

The conclusion just set forth seems too definite and too clearly supported to need reinforcement. If, however, reinforcement be deemed necessary, it may be found by reference to the records of the numerous hearings that have been held from time to time since 1899, before Congressional committees, in connection with bills that have been introduced for the purpose of regulating or preventing experimentation upon animals in the District of Columbia. Certainly, if any such bill could ever have found support in the least degree upon evidence of any specific instance or instances of cruel experimentation on animals in the District, that evidence would have been forthcoming, for there could be no other evidence of so much weight, and yet I can recall no single instance in which any such evidence has been adduced.

It might be argued, however, that even though there be no wrong to be righted by the proposed legislation, yet that its enactment would do no harm and that it would be a very inexpensive way of paying a supposed debt to all dogkind. At best it would be a paying of a supposed indebtedness to dogkind by saddling upon other animals the service now rendered by dogs, which would be a most unjust thing to do, since many other species have rendered to mankind in the war and at all other times service far beyond that rendered by the dog. As a matter of fact, however, those who are best qualified to speak with respect to the subject will tell you that certain experiments in the interests of mankind and of animals generally cannot be as well performed upon other animals as they can be upon dogs. Moreover, one of the witnesses adduced by the proponents of the measure frankly announces that this bill is but the small end of the wedge with which it may be possible to stop all animal experimentation. Under the circumstances, and in view of the lucid statement made by the preceding speaker as to the wonderful benefits that have accrued from animal experimentation, the passage of this bill could never be condoned on the ground that it was at least harmless—for it is not.

The bare fact, however, that the enactment of this bill is unnecessary, and even the fact that its passage would work harm, is not sufficient to prevent the bill from becoming a law. There are persons of wealth, of social standing, and of intellectual standing who believe in it and who have worked and will work actively for its passage. Senators and representatives who will be called upon to consider it are men busy with large affairs of national and international importance, who have but little time for personal research into the merits of measures such as this, and who may be misled by the plausible arguments of the proponents of the bill unless there be an intelligent and energetic cam-

paign to place before these senators and representatives the facts of the situation. It is in such a campaign that Georgetown University is now assuming a position of leadership, and under its banner I ask all of you to enlist and to fight for the cause.

Appendix.

Extract from section one of an Act of the Legislative Assembly of the District of Columbia, entitled:

"An act for the more effectual prevention of cruelty to animals in the Territory of the District of Columbia," approved August 23, 1871

"Whoever, having the charge or custody of any animal, either as owner or otherwise, inflicts unnecessary cruelty upon the same * * * shall for every such offense be punished by imprisonment in jail not exceeding one year, or by fine not exceeding two hundred and fifty dollars, or by both such fine and imprisonment.

"Every owner, possessor, or person having the charge or custody of any animal, who * * * knowingly and wilfully authorizes or permits the same to be subject to unnecessary torture, suffering, or cruelty of any kind, shall be punished for every such offense in the manner provided in Section 1.

"Whenever complaint is made by any member of the Association for the Prevention of Cruelty to Animals (Washington Humane Society) on oath or affirmation, to any magistrate authorized to issue warrants in criminal cases, that the complainant believes, and has reasonable cause to believe, that the laws in relation to cruelty to animals have been or are being violated in any particular building or place, such magistrate, if satisfied that there is reasonable cause for such belief, shall issue a search warrant, authorizing any marshal, deputy marshal, constable, police officer, or any member of the Association for the Prevention of Cruelty to Animals (Washington Humane Society), to search such building or place.

"It shall be the duty of all marshals, deputy marshals, constables, police officers, or any member of the Association for the prevention of Cruelty to Animals (Washington Humane Society), to prosecute all violations of the provisions of this Act which shall come to their notice or knowledge, and fines and forfeitures collected upon or resulting from the complaint or information of any member of the Association for the Prevention of Cruelty to Animals (Washington Humane Society) under this Act shall inure to and be paid over to said association, in aid of the benevolent objects for which it was incorporated. * * *

"Nothing in this Act contained shall be construed to prohibit or interfere with any properly conducted scientific experiments or investigations, which experiments shall be performed only under the authority of the faculty of some regularly incorporated medical college, university or scientific society."

SOME OF THE ETHICAL ASPECTS OF ANIMAL EXPERIMENTATION.

By

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In a world full of sickness and suffering, in which are daily occurring many thousand premature and unnecessary deaths; with a constant struggle going on in the effort to accumulate money, which is today the generally accepted measure of success, there are some unselfish men who, giving up all prospect of pecuniary rewards, or of reputation outside the limits of their own profession, are devoting their lives to reducing the sum total of human and animal disease, alleviating pain and prolonging life. The work in this field has achieved already magnificent results, but much yet remains to be accomplished. Very few people begin to realize what humanity already owes to these investigators, past and present, and will owe to those to come unless irresponsible interference from outside ends their efforts. Yet while the names of great military commanders or men who have accumulated enormous wealth are familiar to everyone, these great benefactors of their kind are known by name only to the medical profession.

Let me illustrate. How many non-medical men or women know who Leishman was or Löffler or Pasteur or Lister or Walter Reed? These men (and there are many others) who have conferred the greatest possible benefits on the race, are little known to the world generally. Yet the first named, Leishman, devised a method of controlling the most common, dreaded and fatal of camp diseases, typhoid fever, which saved at least 290,000 of our troops in the great war, ten divisions, from three or four months invalidism, with 30,000 deaths. The morbidity and mortality from this disease that would certainly have occurred in the great army assembled for this war but for preventive inoculation are calculated on what actually did take place during the Spanish war, before this method of preventing typhoid fever was discovered and introduced. Löffler paved the way for an

anti-toxin which annually saves hundreds of thousands of children from death or crippling from diphtheria. The combined work of Pasteur and Lister has made modern surgery with all its magnificent triumphs possible; and the last, Walter Reed, rescued our South Atlantic and Gulf Coasts from the annual terror of yellow fever, which had ever since the colonization of the country become epidemic at frequent intervals, killed thousands of people, and demoralized commerce every year by the enforcement of the April to November quarantine. All of these great benefits to humanity would have been impossible but for animal experimentation.

The word "vivisection" is unfortunate, misleading and inapplicable to what it is intended to describe. It means simply cutting living tissue. Every surgical operation, involving the making of an incision, is a vivisection, but it is done under an anesthetic, local or general, and the same is true of the research laboratory, but the word to the sympathetic, emotional misinformed man or woman brings up a vivid and distressing mental picture of a helpless animal tied down, struggling and groaning, while a brutal doctor tortures it, with no other object (for it is claimed that no useful purpose is accomplished) than the gratification of a morbid, insane pleasure in inflicting and witnessing suffering. This is true only of criminal degenerates, and is a very false conception of what actually takes place in these laboratories. Instead of "vivisection" the term "animal experimentation" might be used, but even that does not entirely cover the ground, for animals must be used in laboratory diagnosis and in the preparation and testing of certain anti-toxins, sera and vaccines, that have long ago passed the experimental stage, and now provide the sanitarian and the practising physician with their most powerful means of preventing and curing certain very fatal infectious diseases. Many thousand deaths, now easily avoidable, would result if the supply of this material should be cut off, as it would be if the use of animals in scientific work should be prohibited by law.

The suffering inflicted in the type of laboratory work under discussion is grossly exaggerated. A very large majority of the so-called "vivisections" consist of a prick with a hypodermic needle and an injection of the material to be tested or the supplying to or the withholding from animals of certain food elements. Anesthetics are always used in procedures that would otherwise inflict pain.

I am not myself and never have been a laboratory investigator, but I have had under my inspection and control a number of laboratories of this kind in this country and in the Philippines, and have seen a great deal of the work of my subordinates, and I have never witnessed the harrowing scenes so graphically described by the anti-vivisectionists, most of whom have never entered a laboratory. The men engaged in this kind of work are normal men, not at all lacking in the ordinary feeling of humanity, quite as merciful as the average

non-medical man of the educated class, immeasurably more merciful than the sportsman, who hunts for his own amusement, or the trapper who catches animals to secure furs for personal adornment. How often have you heard a big game hunter boast, that though he failed to bring in a deer, he is sure his shot took effect, for the animal limped badly as it escaped and there was blood on the trail? That deer probably, with a shattered hip or shoulder or some even more serious injury, lingered for days in intolerable suffering, finally dying of starvation or exhaustion. At the cost of what untold suffering were secured the furs of the fox, beaver, marten or other animal, that even the most tender hearted antivivisectionist does not hesitate to buy or wear? Yet what is done for sport or vanity seems to be considered perfectly proper and natural, while great indignation is expressed at the relatively negligible suffering inflicted in the laboratory, with the highest possible motive, the search for means for reducing the sum total of human misery, and also the suffering of other animals, for animal experimentation saves in cattle, swine, sheep, poultry and dogs, infinitely more suffering than is inflicted on guinea pigs, rabbits, etc., in the laboratory. The bureau of animal industry, the farmer, the stock raiser or poultry man are dependent on animal experimentation for the study of animal diseases. Any scientific veterinarian will bear me out in this statement. It is a very safe assertion that the suffering inflicted on animals in the laboratory is infinitesimal as compared with the suffering other animals are saved as a result of this kind of research.

The protestants against the use of the lower animals in scientific research, as well as in diagnosis and in the preparation and testing of material of thoroughly proven and enormous value, base their attack on two assertions, both false: First: That intolerable cruelty is wantonly practised in the laboratory. Second: That no useful purpose has ever been secured by this method of research. As said before, I venture to assert that more animal suffering results from one day's sport or from a trapper's successful catch, than is inflicted in years in the busiest research laboratory. Yet no one, so far as I know, opposes big or little game hunting, or refuses to wear furs, because they have been secured at the cost of so much suffering; for imagine a fox, beaver or other animal caught in a spring trap, in cold weather, with a shattered leg, slowly freezing to death, unless as often happens the unfortunate animal, to the trapper's disappointment, secures his freedom by gnawing off his shattered leg. Nothing comparable with that ever happens in a laboratory, but it is a common occurrence in trapping fur-bearing animals.

The second statement that nothing of importance has ever been developed by animal experimentation can be believed only by people incapable of understanding facts or being convinced by absolute proof, or actual demonstration. The whole science of physiology, the study

of the working of the animal mechanism, is built up on animal experimentation. But for it we should know nothing of the circulation of the blood, the functions of the viscera, or the brain, spinal cord and nervous system generally. We should be no further advanced in knowledge of this subject than were Paracelsus or Avicenna, or than is now the old fashioned Chinese doctor, who teaches his students that the intellect resides in the spleen, and the soul in the left kidney. No new drug used by the physician could be safely employed in treating sick human beings, till its effects were tried out on lower animals. Anesthesia, one of the greatest of benefits to mankind ever devised, would never have been introduced and used as it is today, with incalculable saving of suffering (animal as well as human) but for the use of animals in testing its safety and its general effect.

The whole of bacteriology and modern surgery have been slowly worked up to their present position among the sciences by animal experimentation. No surgeon would dare to remove a kidney or suture the intestine, no matter how badly damaged, unless it had been shown it could be done in anesthetized animals with perfect safety, and without suffering. Remember, in passing, that even if all investigators in this field were entirely devoid of the ordinary human instincts, which, of course, is nonsense (what logicians call a "violent supposition") it would be impossible to do a delicate dissection on an unanesthetized struggling animal.

Aseptic surgery, one of the greatest triumphs of modern times, would be impossible without animal experiments. I am old enough and young enough to be able to contrast the surgical conditions of forty years ago with the magnificent surgical successes of today, impossible without animal experimentation.

The study of the ultimate cause of diseases, which is the first step in finding means to prevent and cure them, has made enormous progress, but much still remains to be done. An intensive study is going on all over the world to find the cause, prevention and cure of cancer. There is still much to be learned of small-pox. The ultimate cause of scarlatina, measles and mumps are unknown, that of influenza not definitely determined. There are many other problems of this kind to be solved. Put a stop to animal experimentation and the search must be abandoned. Incalculable disaster to the human race and to the lower animals would result, many epidemics now controllable would spread unchecked. The resulting misery and death no man can begin to calculate, and medical progress would be completely arrested. It is undeniably true that medicine and surgery owe the bulk of what they have accomplished in the last fifty years to animal experimentation.

Let me state from my own observation and experience what was accomplished in the eradication of disease in the Philippines in nine years, most of it the result of animal experiments, and methods de-

veloped and worked out in the laboratories of different countries, largely by animal experimentation. When I left Manilla, after two years stay there, in 1902, the hospital I commanded contained about 500 very sick men (all light or convalescent cases were sent to a convalescent hospital). These cases included small-pox, plague, beri-beri, Asiatic cholera, typhoid fever, and a great many of tropical amebic dysentery. On my return nine years later as Chief Surgeon of the Philippines I inspected the same hospital. There were 73 cases being treated then and not one case of communicable disease. The changed conditions were the result of American Sanitation, inaugurated by military and carried on by civilian health officers, but the methods by which that improvement was made possible, were the result, in the final analysis, of animal experimentation.

Take one disease as an illustration. Beri-beri (known to medical men as disseminated peripheral polyneuritis) was a disease at first unfamiliar to doctors who had had no tropical experience. It affects the nerve endings, causes extensive paralysis, and some of the most frightful cripplings you can imagine. At first this was supposed to be an infectious disease. It very rarely occurred among our troops, but was a scourge among the natives, and most of them who did not die from it would have been much better off if they had, for many muscles became permanently paralyzed, opposing muscles dragged the unfortunate sufferers into the most distressing permanent contortions. The cases were all isolated, and not one of them, or very few, indeed, got well. Two years later during the Japanese-Russian War, the Japanese Navy suffered badly from beri-beri. The surgeon general of that service proposed a change of diet, and the cases improved and new cases ceased to appear. Later on the matter was seriously studied, and Vedder, of the U. S. Army Medical Corps, made a series of experiments on fowls, simply restricting their diet to polished rice, which forms the bulk of the subsistence of the Filipinos and the Japanese. He found that chickens developed symptoms of beri-beri which promptly disappeared when rice polishings were added to their diet. Now beri-beri is almost unknown in the Philippines. In three years I spent there, 1911-1914, I never saw a single case. The fact that it was a diatetic disease, a deprivation neuritis, was definitely proved on a dozen fowl, and by insisting on the natives eating unpolished rice the disease has practically disappeared, for there is some element in the husk or the pericarp of the rice grain that contains an essential food principle, found in the ordinary diet of all persons except those whose food is almost entirely starch. This is a good illustration of what may be accomplished by animal experimentation. Simply restricting the diet of a few fowls for a time proved positively the cause of this disease. One of the methods of proving Vedder's theory was to give the fowls rice polishings as soon as symptoms of paralysis developed, when they very soon disappeared.

If I were allowed thirty hours instead of thirty minutes, I should find the time too limited to enable me to enumerate and describe the great benefits to the race that these great investigators have bestowed upon it through animal experimentation.

Should not every intelligent man or woman, worthy to be called civilized, do all in his power to encourage and help these unselfish benefactors of the race? Can you conceive of people calling themselves educated or intelligent, so misguided as to misrepresent, hamper and even to make every effort to put a stop to a kind of scientific work that has already conferred incalculable benefits on the human race and domesticated animals, and is full of promise of even more than it has already achieved.

Yet there actually are such people. If they would confine themselves to anything remotely resembling the actual facts, they could easily be silenced, but they harrow up the feelings of unthinking emotional people with the most absurd and extravagant misstatements. Only a few days ago in this city one of these propagandists made the assertion that medical students were forced to witness the torture of dogs, in order to make them callous to the sight of suffering, harden them morally and eliminate all humane instincts from embryo medical men. Can there be approximately intelligent people, who can listen patiently to and even believe such fantastic nonsense? The answer is "no," for to credit such absurdities is in itself proof of the nonexistence of any intelligence at all.

WHAT ANIMAL EXPERIMENTATION HAS DONE FOR GYNECOLOGY AND ABDOMINAL SURGERY.

By

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To discuss adequately this important subject would require more time than your patience would allow, and I am reminded of the statement made by President Hadley, of Yale, that no one is converted after twenty minutes. Consequently, in the time at my disposal I shall give you only a panoramic view of the advances in abdominal surgery and gynecology during the last thirty years.

We are continually reminded of the wonderful way in which nature has developed our bodies, and in no part of the human economy is this more evident than in the abdomen. It would be impossible for any man, no matter how skilled he was, to pack away in a small compartment so many vital structures, and to so arrange them that no one organ seems to be crowding out the other.

If we examine the abdominal cavity, we find that it is in large measure filled by the gastro-intestinal tract. The upper part of this is the stomach. Next comes the duodenum which is only a few inches long and is continuous with the small intestine which is many feet in length. This, in turn, passes into the large bowel through a valve-like opening, in the vicinity of which is the appendix. The large bowel is a few feet in length and terminates in the rectum. The intestines as a whole are over twenty-two feet long.

Occupying the right upper abdomen and lying chiefly under the ribs is the liver and snuggled up under the edge of this organ is the gall-bladder. In the left upper abdomen is the spleen, and lying practically behind the stomach is the pancreas.

In the female the pelvis contains the uterus, tubes and ovaries. Lying outside the peritoneal cavity on either side are the kidneys and from each a small tube, the ureter, passes downward to the base of the bladder. Such is the general topography of the abdomen.

Some of the older members of my audience will probably remember that thirty years ago one rarely heard of an abdominal operation except for the removal of an ovarian cyst. At that time we had cases of typhilitis, a term used to designate inflammation around the appendix, or were told that a patient had liver trouble or an inflammation of the gall-bladder, but no operation was suggested or performed for any of these important conditions.

During those dreadful epidemics of typhoid fever that from time to time passed over a community like a prairie fire, a perforation of a typhoid ulcer was diagnosed and that meant almost certain death, as the surgeon was unaware that operation could be of any value.

As we glance back to former days we remember that many of our friends were chronic invalids, and we looked upon their permanent disability as a matter of course, little realizing what might have been accomplished had they the advantages of the wonderful advances in abdominal surgery made during the last quarter of a century. Just imagine the dilemma we should be in today if none of our appendix or gall-stone cases could be operated upon!

The normal appendix is about as big around as a small lead pencil and varies from two to three or more inches in length. It is a very innocent looking object, and one would not for a moment think it could do harm. Nevertheless, it is the "stormy petrel" of the abdomen. It is lined with the same velvety membrane as that of the large bowel, and its lumen which is about the size of the lead in a lead pencil is continuous with the cavity of the bowel. We all know how quickly a nostril will close if we catch the slighest cold. If there be a slight inflammation of the large bowel this often extends to the appendix, and its opening into the bowel speedily closes. It is now a closed sac, and if the inflammation persists the appendix swells up

and finally gives way at some point allowing its foul contents to escape into the abdomen. General peritonitis often results and the patient dies. Appendicitis was the "inflammation of the bowels" of former days.

Many of you will doubtless wonder why the various stages in the development of appendicitis were not thoroughly understood long before, but when we remember that abdominal operations for this condition were not performed and that when the abdomen was opened after death in the cases in which peritonitis had developed, pus was found everywhere, we cannot wonder that the true cause was usually overlooked.

If one is in a house when it catches fire he is usually in a position to tell how it started, but when the whole building is ablaze when he reaches the scene it is very difficult, or impossible, to determine the starting point.

To Louis Pasteur, the people of the world owe an eternal debt of gratitude for his discovery of the usual causes of infection or blood poisoning; it was he who pointed the way to avoid infections. His discovery was promptly embraced by Joseph Lister who applied it to surgery. As a result of the labors of these two men it was soon possible to open an abdomen with little or no fear of subsequent infection. This opened up to the surgeon an entirely new field, one heretofore in large measure forbidden ground. It likewise enabled him to explore the abdominal cavity in very early stages of various abdominal diseases. He was thus not only able to follow the disease from its beginning, but, what was more important, was often able, figuratively speaking, to confine the fire to one room and to extinguish it effectually.

When a new country is thrown open to the public the desirable farm land is soon taken. Small villages spring up, roads are located, and in due course the community is thoroughly organized and takes its proper place in the State. Precisely the same thing has taken place in abdominal surgery. At first the appendix and gall-bladder were given special attention because in these originate the two most important and most frequent abdominal maladies that the abdominal surgeon has to deal with. After these had been thoroughly mastered other and less frequent abdominal diseases were given due consideration.

Perhaps I may be able in a few words to give you a comprehensive idea of the more common abdominal conditions with which the surgeon has to deal.

In the stomach we have ulcers. These may cause alarming hemorrhage or perforation may occur. The surgeon makes an opening between the stomach and intestine in such a way that the food does not pass the ulcer. This leaves it quiescent and gives it a chance to heal. If a perforation has occurred, he at once sews up the hole and drains the abdominal cavity to get rid of the stomach contents that have escaped.

When cancer of the stomach is detected early he removes a portion of this organ and usually attaches the remaining part of the stomach to the intestine, in such a manner that the contents can readily pass along their way.

Ulcer of the duodenum is of common occurence. Here practically the same operation is performed as for ulcer of the stomach.

Throughout the various portions of the small and large intestine tumors may develop. The necessary segment of the bowel is cut out, the cut ends are approximated, and in many cases the patient makes a perfect recovery.

In the female we often find pus in the tubes connected with the uterus, and it is usually necessary to remove these if the patient is to regain her health. It is a significant fact that pus tubes are infinitely less frequent in the well-to-do than they were a decade ago. This is undoubtedly due to the better education of the public and to the fact that women in the higher walks of life will have nothing to do with their husbands if the latter be infected. The next decade will undoubtedly show the same attitude on the part of the women in other walks of life. These facts were emphasized by Dr. Roland Hill in his recent Presidential address delivered before the Western Surgical Association in Kansas City. They are most significant.

Uterine and ovarian tumors in their development often push the blood vessels, the tubes from the kidneys to the bladder and other structures, far out of place so that the surgeon finds it difficult to get his landmarks. In such cases he is often like the mariner traversing an uncharted sea. Sometimes the tumors reach a very large size and grow so fast to the intestines and large blood vessels that it is necessary to remove parts of the intestine and occasionally portions of the important blood vessels together with the growth.

Now and again a crisis arises and almost certain disaster seems imminent. It is then that the surgeon must act with instant decision and with the utmost coolness. He cannot back out, and any minute may be on the rocks. When in such a predicament I have been reminded of the man in the signal tower. The limited was coming rapidly toward him and beyond control. A moment's delay and a head-on collision would occur. He thought quickly—"better one wreck than two"—pulled the lever and sent the limited into a mud bank.

No man has any right to do abdominal surgery unless he is prepared to do any abdominal operation that may be necessary, and unless he is ready to cope with any abdominal emergency at a moment's notice. You may be able to duplicate a train—you can never reproduce the same individual.

An abdominal surgeon must in the first place be a man with a good fundamental knowledge of medicine. He must be a good diagnostician; he must be thoroughly familiar with the gross appearance of all abdominal lesions and also with the appearance of these structures

under the microscope. He must be a good bacteriologist so that he can carry out the technique of the operation in such a way that there will be little or no chance of subsequent infection.

He must be able to join up intestines so that they will not leak or will not allow gas to escape. He must be able to join blood vessels so securely that the blood stream will be continuous, and he must approximate parts in such a manner that they are left perfectly smooth. In short, in addition to his scientific qualifications he must be a good plumber and gas fitter, and a first-class tailor.

The successful surgeon does not confine his knowledge to medicine and surgery alone, but embraces every opportunity to learn all he can about business in general, and especially concerning manufacturing plants of all sorts. In this way he picks up many points that are invaluable to him in his chosen field. Above all a liberal supply of good horse sense is his most valuable asset.

Problems.

Nearly all manufacturing plants retain a corps of experts who are continually on the look out for new things and who are suggesting new methods whereby the existing products are improved and produced with less cost. Precisely the same applies to abdominal surgery. Our methods are as a result of experiments rendered more effective and as a result of animal experimentation we are rapidly reducing the cost—in lives.

The experimental intestinal work of Halstead, Mall, Murphy and others upon dogs has been of the greatest value. They have given us methods of so bringing the bowel ends together that we now rarely have a leak after the ends have been approximated.

As a result of experimental work we are now able to bring together the ends of blood vessels with the assurance that the blood will continue to pass normally through this spliced vessel.

In some operations the tube from the kidney to the bladder has been cut across during the operation, not through any fault of the operator, but because it has been carried far from its normal position by a tumor. As a result of experimentation on animals we now know how to join up effectually the ends of the cut tube and thus save the kidney which would otherwise have to be sacrificed.

In former days when a patient had a strangulated hernia which had existed for four or five days he would usually die even after we had released the bowel. Animal experimentation has taught us that the death was due to poisons absorbed from the temporarily paralyzed bowel. We now open the bowel above the point of the hernia, allow the poisonous intestinal contents to escape and achieve success where failure usually followed.

As a result of experiments on animals we have learned that chloroform causes widespread necrosis of the liver; hence this anesthetic has been practically discarded in this country, except in obstetrical cases where it is employed only for a few moments.

As a result of experiments on animals we have been able to discover how much intestine can be removed and the patient still live.

As a result of experimentation a knowledge of the stomach juices was learned.

These are but a few of the fundamental truths that have been ascertained as a result of operations on animals—truths that have enabled the surgeon to save myriads of lives.

The question is often asked, "Why use the dog?" In many laboratory experiments mice, rats, guinea-pigs, rabbits and other animals have been employed. In experimental work dealing with the advancement of abdominal surgery we have to use a larger animal, an animal whose abdominal organs resemble in some degree those of the human being, and the dog is the only animal that we can satisfactorily employ.

It may be of interest to describe briefly the method of operating on dogs. The instruments are carefully sterilized by boiling. The sponges and dressings are prepared in precisely the same manner that they are in a hospital operating room. The operator and his assistants scrub up and go through the same solutions that they employ in preparing for a regular abdominal operation. A trained assistant is selected to put the dog to sleep and the abdominal preparation of the animal is carried out with the utmost care.

The operation itself is carried out with the same precision that is in vogue in any well-organized operating room, and the operator is keen to see if he can successfully perform the new operation that will in the future enable him to relieve conditions in the human being that have heretofore baffled the surgeons.

As soon as the operation has been completed the dog is placed in a comfortable cage and given morphia or some other drug that will in large measure relieve his suffering. His diet is also carefully supervised until he is able to be up and around again. This scrupulous care of the animal is absolutely essential otherwise many of these valuable and successful experiments would end in failure.

It is interesting to note that, when the animal operating room at the Rockefeller Institute was established, the head nurse of one of the best operating rooms in the country was selected to take charge of this department.

When a physician who was visiting the Rockefeller Institute dropped in to see the dogs that had been operated on they immediately started to bark furiously, but as soon as the surgeon who had performed the operations and watched them subsequently appeared their barking ceased and the dogs wagged their tails furiously. The dogs,

of course, did not know that the surgeon had produced their suffering. They were asleep. They only knew that he had been kind to them when suffering. Further comment is unnecessary.

The Training of Young Surgeons.—The public has a right to demand the best surgical service obtainable. In the early days many a man after years of general practice gradually drifted into operating. The surgery of today requires such perfection in diagnosis, such a knowledge of pathology, operative technique and after treatment that the embryo surgeon must after spending one or two years in a medical clinic start at the bottom rung of the surgical ladder and work up. He will begin as a junior assistant taking histories on the wards, making the necessary routine laboratory examinations, handling instruments at operations, and in looking after the patients that have been operated upon. After a year in such work he may become a second assistant. His responsibilities are now greater, and he may be allowed to do minor operations. When he has won his spurs he is advanced to be first assistant, and finally becomes the resident surgeon in the hospital.

The assistant learns much from his chief, and in due time is able to perform complicated operations, but there are some that he can rarely if ever successfully perform the first time. This is perfectly natural. The plumber's assistant might watch his employer successfully weld joints for months without being able to do so himself. In order to become a master plumber it is necessary for him to do some of the welding himself, and some of his first attempts in this direction are doomed to failure. With the plumber's apprentice this does not matter much; he can try over again, and if necessary secure new pipes. When the surgical assistant attempts for the first time to bring the two ends of a bowel together and so suture them that the joint is absolutely water and air tight he is often doomed to failure and the patient, if a human being, usually succumbs. It is essential that he do the operation on dogs first and after one to four or five trials he can with ease make a perfect joint.

The same applies where he has to join up the small tube that connects the kidney with the bladder. It also is applicable in several other abdominal emergencies.

When we look at the subject squarely it resolves itself into this—in the first two operations in which abdominal tubes are to be joined up failures are bound to result and death ensues. It is better to lose a few dogs or a corresponding number of people while the surgeon is securing the necessary skill in the performance of these important and difficult procedures?

Surgeons are often thought to be lacking in sympathy, but I have never met a more warm-hearted group of men. The nature of their calling, however, does not allow them to let their feelings run away with their judgment. They are often called upon to operate upon

their nearest and dearest relatives, at times not knowing whether they will be able to get them off the table alive. There is nothing in this world that pulls harder on the heart strings of any man than such an ordeal, and yet throughout the entire operation the surgeon must combine consummate judgment with absolute coolness, otherwise he cannot do his best. There is little wonder that the busy surgeon must take frequent vacations, otherwise he would snap under the strain.

To physicians and surgeons the innermost life of the community is laid bare. The veneer and camouflage of society are torn aside, and the true life of society as it actually is stands out in bold relief before him. Could any man except one with a heart of stone under such circumstances fail to develop to a large degree an unbounded sympathy with mankind?

All surgeons have been small boys, and it is the exception to find a lad who does not love animals and above all dogs. Well do I remember the mongrel dog that was my boon companion, just after I had learned to toddle around. The pranks of my large New Foundland dog, Ponto, will always linger in my memory.

That splendid thorough-bred collie, Toby, was a delight to us all, but like some of his race he occasionally exhibited diabolical qualities, and like a flash would bite members of the family. In a moment his anger subsided, and for days he would in every way manifest his sorrow for the outburst. When it became necessary to put him to sleep on account of his being a menace to the neighbors there was a sadness in the family akin to the loss of one's very own.

Late one warm July night in 1906, long after we had retired, the door bell rang, and the expressman brought in a small crate. On opening the door of this a small, shaggy mite four weeks old and not over six inches long toddled out. At first he was very shy, but after drinking a saucer of milk became friendly. In a few days he owned the house. He had the usual children's diseases, such as distemper and intestinal upsets, and in each of these was tenderly nursed.

Like all young children he manifested a tendency to run away, and on one occasion was missing for two days. Scotties are no beauties, and an advertisement for "an ugly-looking little black dog" brought him back promptly. When four or five years old he was desperately ill, and we feared for his life. He was at once taken over to the Hunterian Laboratory—the dog hospital of the Johns Hopkins Medical School—and put under the care of the young surgeon in charge. Appropriate treatment was at once instituted, and when we left him there, those wistful and pleading eyes followed us to the door. No human being could have spoken more plainly. Next morning we went over to the hospital expecting to find him dead. Imagine our joy and surprise to see him running around the cage and wagging his tail furiously.

One summer we went to Europe and he was put out to board. On our return a more seedy and bedraggled little animal could not be found. That settled it, he has his own trunk, and each year he travels with the family to the back woods of Canada where for two months he is continually busy in chasing chipmunks, digging holes and in locating bones that he had buried in previous years.

For a long period he and I lived alone, and each night he was faithfully waiting for me at the head of the stairs, and each night he and I went for a walk before retiring. Sometimes, when an emergency operation has detained me late into the night, our stroll has been deferred until 1 or 2 o'clock in the morning, but he never misses it when I am home.

Killie is now nearly fourteen years old. He cannot climb as he once could, he has a cataract in one eye, and he is an old man, but he is still an inseparable member of the family and beloved by all. He has brought untold happiness to the household and is a most valued friend. As I write this he is lying at my feet.

If one of my family were desperately ill, and if it were necessary to try some animal experiment with the hope of saving their life, and if it were impossible to secure another dog for the purpose, then I should with great reluctance be forced to operate on Killie. Physicians and surgeons in the past have not only risked, but given their lives for their patients and will continue to do so in the future. We can well imagine the agony in the heart of Abraham when he was preparing to offer up his son, Isaac, as a sacrifice.

When considering the subject of vivisection I am continually reminded of the woman who was visiting an asylum. In her curiosity she opened a door and saw a man riding a broomstick. Though somewhat startled she said, "I see you are riding a horse." The man replied, "No, it is a hobby, if it were a horse I could get off." We all have our hobbies, or should have them. It is the man or woman who has a hobby that accomplishes things, but in following out our hobbies let us view the subject from every standpoint, let us see if we are on the right track.

In the Hunterian Laboratory at Hopkins and catching ones eye as he enters the building is a conspicuous list of rules which are and have been rigidly enforced for years. Among other rules is the following: "Any attendant who strikes a dog is to be discharged at once." Every precaution for the humane treatment of animals has been scrupulously observed.

We should be as careful and considerate of animals as we are of people, but if by the experimentation on a few animals we can save many lives, is it not our duty to do so? Would you be willing to lose one of your dear ones rather than have the surgeon sacrifice a few dogs—you certainly would not when the acid test came.

What would you think of an apprentice carpenter being given valuable mahogany to work on. You would consider it absurd. He should practice on the cheapest kind of lumber until he has gained sufficient skill to handle adequately the rare and more costly woods. Human beings are the mahogany of surgery.

Why is it that American surgeons when ill abroad and needing surgical operations, if possible, take the first boat for America? It is because they feel that they can get better surgical treatment in this country than anywhere else in the world. The wonderful advances in American surgery have in no small measure been due to the careful and painstaking animal experiments carried on in the United States.

The people of the world owe a tremendous debt to Louis Pasteur, to Joseph Lister and to the results of animal experimentation. Myriads of useful men and women, now alive and well, would have long since passed to their eternal resting place had it not been for the fundamental discoveries of Pasteur and Lister, and for the new and better methods revealed to us by experiments on dogs.

The citizens of the United States, when ill, rely absolutely on the judgment of their surgeon and place themselves and their families under the care of these surgeons, knowing full well that they will receive the best possible surgical care. Such being the case, the public can with confidence rely on the surgeon to be careful, conscientious and humane in his experimentation on dogs, which is absolutely essential to the continued advancement of this important branch and to Medicine as a whole.

ACHIEVEMENTS OF ANIMAL EXPERIMENTATION IN GENERAL SURGERY.

By

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Man in the beginning was given control of all inferior animals for use, but not for abuse, and this right to use extends to confining the animals in captivity, making them work for him, and even taking their lives for any good and sufficient reason.

Man gives his own life and often sustains great hardship and suffering in support of a worthy cause, or for the benefit of his kind; then why should he hesitate to use the lower animals, who have been given into his keeping, for any worthy purpose?

I am as much opposed to cruelty in the true meaning of that word as the most violent and senseless antivivisectionist, but the use of ani-

mals and their sacrifice at times even with suffering, when done for the benefit of the human race, is not cruelty.

I have read a number of attacks on all who believe in the principles I have just stated, and especially on the members of the medical profession, but the most remarkable and amusing of them all is a book by Stephen Coleridge.

Stephen Coleridge, in his book entitled "Vivisection—A Heartless Science," 1916, feels it his duty to attack vivisection as he is a representative in the fourth generation from the one who wrote the "Ancient Mariner," and modestly continues, "I may claim with some pardonable pride to have acquired my convictions from three generations of ancestors, whose title to distinction in the fields of law and letters cannot be gainsaid."

After reading his book one is compelled to believe that however much he may know of "law and letters," his knowledge of physiology is woefully deficient. To select one from the numerous examples of erroneous deduction, ignorantly or wilfully made, read his criticism of certain experiments made on animals by keeping them continually under the influence of alcohol, as showing his idea of cruelty:

"Surely it is time that all decent men and women in England raised their voices in solemn protest against these dreadful claims of physiology, claims that revolt the heart and shock the conscience."

Coming from a man of such pride in his logic, education, and hereditary convictions, this hysterical outburst is surprising over a condition in which the animal is blissfully unconscious of worry and certainly free from all pain.

The issue, he writes, is "whether vivisection as practiced is right, not whether it is useful to science."

What sophistry—the killing of a man in the abstract is not right, yet it is universally conceded that circumstances often make it right. He attacks the support or aid of medical schools by hospitals, criticizing Lord Lister's approval, and pays his respects especially to the affairs of St. Bartholomew's Hospital, conclusive evidence that he fails to see the benefit which the schools with their students and physicians bring to the hospital, and showing his prejudiced and distorted opinion of the medical profession.

The deductions from Sir Victor Horsley's answers to questions by the Royal Commission on Vivisection are unfair and unwarranted; the insinuation that men like Brunton, Powers, Schaefer, Morris, Swazey, Bruce, Osler and others obtained their honors by practicing or supporting what he regards as an infamous practice, is slanderous; but the tribute to the leading lights of science in America, in the suggestion that asses' ears be grafted on the heads of the operators, is amusing, as the idea instantly occurs to the reader that the head of the author would be much more appropriate for adornment with these emblems of unreasonable obstinacy and stupidity.

To read the author's own account of how he has punctured the inflated arguments of his opponents with his irresistible logic, marks him as a regular Boanerges in control of the lightning and thunder, and to oppose his judgment or opinion is to invite destruction.

The charge of megalocephaly (bigheadedness) made against Sir Edward Schaefer is another instance of transferring one's own peculiarities to the shoulders of another. The entire tone of the book forces the conclusion that the author is a man whose self-conceit is colossal, whose skill in distorting language from its honest meaning to suit his purpose is phenomenal, but whose faith in the integrity of those who differ with him is pitiable, and whose logic is ridiculous.

Let us hear now some of truth and soberness: After the Royal Commission on Vivisection had concluded its sessions and the examination of numerous advocates and opponents of vivisection, the Earl of Cromer, who might be regarded as an unprejudiced party, thus expresses his opinions:

"I felt strongly that the vivisectionists and not their opponents were the true humanitarians. * * * The argument that the researches of the vivisectionists have been barren of results ought to be finally discarded by all save those who are not open to conviction. * * * The case of the antivivisectionists, when submitted to the test of cross-examination, broke down helplessly."

A word now regarding some of the benefits we enjoy from animal experimentation.

Seventy-five years ago little was known as to the exact relations between the anatomy and the functions of the brain, spinal cord and nerves. Watson in 1845 (Head) said: "The structure of the nervous system has no perceptible or understood subservience to its functions," and he believed that the brain was the seat of a sort of generalized function with no special centers. Now we know, thanks to the experiments of Ferrier, Hitzig, Sherrington, Greenbaum and others, on the brains of monkeys that every motion and sensation in the body has its center or little group of cells in the brain which control it, so that any stimulation or injury to that center in the brain is shown by a certain sensation or movement of the muscles of the part so controlled. It is an ordinary event now, in injury or disease of the brain for the surgeon by observing, for example, movements or paralysis of the muscles of the foot, hand, eye, mouth, etc., to know exactly in what part of the brain to look for the blood clot, tumor or whatever may be causing the trouble.

This was illustrated in the case of a prominent presidential candidate, when twitchings or paralysis began in one of his feet, the surgeon knew just where to look for the cause in the brain, namely, the center controlling that foot, so he opened the skull and found and removed a tumor.

It was Charles Bell's experiments on a donkey about 1811 that established the difference in function between the fifth and seventh cranial nerves and thus enabled us to operate successfully on thousands of cases of neuralgia of the face.

The surgery of the thyroid gland and the intelligent treatment of goitre was worked out by animal experimentation; even great anatomists like Luschka having no appreciation of the functions of the thyroid or parathyroid glands and their important relation to life and health. In the first operations sometimes all of the thyroid and parathyroid glands were removed, when the patient either died in convulsions or lived a short, crippled life with bloated features, cold and thickened skin, intellectual stupidity, ending in imbecility. By investigation on animals it was found that when all of the parathyroids were removed, the animal dies of tetany, so that now in surgical operations for goitre we are always careful to leave at least one parathyroid gland.

Before removing the larynx for cancer in man, Czerny experimented on dogs and found that they survived the operation and continued in good health, and now it is an established life-saving operation for man.

Likewise Simon in 1869, before removing a kidney from man, established the fact that dogs survived the loss of one kidney without any detriment to their health, and that is now a very common operation for malignant tumors, tuberculosis, abscess, stone, etc., and the man lives and enjoys life seemingly as well off with one kidney as with two.

In 1867 Ollier proved by experiments on animals that bone or periosteum would live and grow and make new bone if transplanted from one part to another of the same animal, or if transplanted from one animal to another animal. From the knowledge obtained in this manner have come the numerous and wonderful operations on bones.

In older times surgeons could make a new nose (for one whose nose had been destroyed) by turning down a flap from his forehead or getting a flap from his arm, but it was a soft, mushy nose. Now, when this is necessary, we transplant a piece of bone to stiffen the soft parts, obtained from the outer table of the skull, from the end of a finger or from one of the ribs. Parts of the skull are sometimes destroyed by wounds leaving the brain covered only by the soft parts which may cause fits or lead too easily to injury to the brain. These defects in the skull are filled in now, not by silver or celluloid plates, as was formerly done, but by bone obtained by splitting off a piece of the outside table of the skull near the defect or by cartilage obtained from the ends of the patient's ribs. A long bone partially destroyed may have the gap filled in by transplanting a fragment from some bone large enough to spare it—placing and fixing the fragment between the ends of the two fragments and holding it in place until union occurs.

Where the thumb has been lost or all the fingers, a substitute for the thumb for the fingers to press against, or a substitute for the fingers for the thumb to press against, has been made by transplanting a suitable bone or fragment and fixing it in its new position. For the treatment of tuberculosis of the spine, which leads to hunchback, a fragment taken from the larger bone in the leg is transplanted into the part of the spine which is diseased in order to hold the parts at rest until cure takes place and prevent the deformity of hunchback.

Even entire joints, as the knee, have been transplanted successfully—the diseased joint is cut out and a healthy joint of proper size from a recently amputated limb is fixed in its place until union occurs.

Metchnikoff in 1903 inoculated apes with syphilis, and in 1905 Schaudin and Hoffmann discovered the germ of the disease. A few years later, in 1910, Ehrlich discovered his famous 606, or salvarsan, after 605 other remedies had been tried unsuccessfully.

In 1876 Gussenbauer and Winiwarter experimented on dogs' stomachs and were surprised and pleased to find after cutting out pieces and sewing them together that the parts united and grew together as kindly as do wounds of the skin, instead of being digested or destroyed by the gastric juice as was the common belief.

In 1861 Billroth did the first successful pylorectomy (excision of a portion of the stomach) on the human being. In 1884 few surgeons were bold enough to open the abdomen even for the treatment of gunshot wounds. Then it was that Parkes, at Chicago, experimented on thirty-seven dogs by shooting them through the bowels while etherized, then operating on the wounds and proved that opening the abdomen and sewing up the bullet holes was the best method of treatment. This has led to the saving of thousands of lives, and the surgeon of today who fails to operate in such cases would be negligent of his duty.

Not only do we operate for wounds of the stomach and bowels, but for many diseases, such as cancer and ulcer. A portion of the stomach containing the cancer is cut out and the ends sewed together, or the ends may be closed by stitches and a new opening made between the stomach and the bowel. When the disease is so far advanced that removal is impossible, the stomach or the bowel above, and the bowel below the disease, which causes obstruction are united, "short circuited" as it is called, so that the obstruction is relieved and the patient's life prolonged and made more comfortable. It was also found that the entire stomach could be removed and the patient live. Schlatter at Zurich, Switzerland, did the first successful complete removal of the stomach in 1897, and the patient lived about one year, dying of a return of the disease (cancer) in some other form. Since then the operation has been done many times with good results.

Forty years ago no one had dared to operate on a human heart. If it was penetrated by a knife or bullet, the patient was permitted to die without any interference on the part of the surgeon. Even with

this method of no treatment some patients recovered, and in 1867 Fischer published a list of 456 wounds of the heart with an estimated recovery of 5 to 10 per cent; but as no operation was done, it is probable that most of the recoveries were in those in whom the heart had not been wounded, and it would be nearer correct to assume that recoveries from penetrating wounds of the heart treated by the "watchful waiting" plan would not exceed 5 per cent.

In 1895 Rosenthal and Del Vacchio made a number of experiments on dogs and found that they could be cured when the heart was wounded by opening the chest and sewing up the wound in the heart. The next year Farina, of Rome, sewed up a wound in the heart of a man, and the man lived six days and died of pneumonia. During the same year Rehn performed the first completely successful operation of sewing up a wound in the heart. Twelve years ago (1908) I collected 150 cases in which wounds of the hearts had been sewed up and 35 per cent(52) of the patients recovered—a gain of about 30 per cent over the do-nothing method. Since that time many other patients with wounds of the heart have been saved by operation.

All of us hope to see the time when diseases of the heart can be operated on and cured in the same way. In diseases of the heart, the valves often become too small, or the natural openings by which one chamber opens into another or into the great blood vessels, become too large or too small, so a leak occurs.

Carrel and his co-laborers at the Rockefeller Institute have demonstrated the fact that in dogs the valves in the heart and the natural openings can be sewed up, enlarged, or reduced in size without killing the animal. In the same way large blood vessels which have been wounded have been preserved by sewing up the wounds, or where they have been divided by sewing the ends together, or where much of the vessel has been destroyed, by transferring a piece of another vessel which can be spared to take the place of the portion, which has been destroyed.

In several cases one lobe (that is nearly half) of one lung has been successfully removed, and in one case Lilienthal removed almost the entire lung with recovery of the patient.

I cannot do better in closing than to quote the words of Dr. W. W. Keen, the Nestor of American surgery, in comparing the achievements of the friends of experimentation with the achievements of its opponents.

UNDER EXPERIMENTATION.

"1. They have discovered and developed the antiseptic method, and so have made possible all the wonderful results of modern surgery.

"2. They have made possible practically all modern abdominal surgery, including operations on the stomach, intestines, appendix, liver, gallbladder, pancreas, spleen, kidneys, etc.

"3. They have made possible all the modern surgery of the brain.

"4. They have recently made possible a new surgery of the chest, including the surgery of the heart, lungs, aorta, oesophagus, etc.

"5. They have almost entirely abolished lockjaw, after operations, and even after accidents.

"6. They have reduced the deathrate after compound fractures from two out of three; i. e., 66 in a hundred to less than 1 in a hundred.

"7. They have reduced the deathrate of ovariotomy from 2 out of 3 or 66 in a hundred to 2 or 3 out of a hundred.

"8. They have made the deathrate after operations like hernia, amputation of the breast, and of most tumors a negligible factor.

"9. They have abolished yellow fever—a wonderful triumph.

"10. They have enormously diminished the ravages of the deadly malaria, and its abolition is only a matter of time.

"11. They have reduced the deathrate of hydrophobia from 12 to 14 per cent of persons bitten to 0.77 per cent.

"12. They have devised a method of direct transfusion of blood which has already saved many lives.

"13. They have cut down the deathrate in diphtheria all over the civilized world. In 19 European and American cities it has fallen from 79.9 per hundred thousand of population in 1894, when the antitoxin treatment was begun, to 19 deaths per hundred thousand in 1905—less than one-quarter of the deathrate before the introduction of the antitoxin.

"14. They have reduced the mortality of the epidemic form of cerebro-spinal meningitis from 75 or even 90-odd per cent to 20 per cent and less.

"15. They have made operating for goitre almost perfectly safe.

"16. They have assisted in cutting down the death rate of tuberculosis by from 30 to 50 per cent, for Koch's discovery of the tubercle bacillus is the cornerstone of all our modern sanitary achievements.

"17. In the British Army and Navy they have abolished Malta fever, which, in 1905, before their researches, attacked nearly 1,300 soldiers and sailors. In 1907 there were in the army only 11 cases; in 1908, 5 cases; in 1909, 1 case.

"18. They have almost abolished childbed fever, the chief former peril of maternity, and have reduced its mortality from 5 or 10 up even to 57 in every hundred mothers to 1 in 1,250 mothers.

"19. They have very recently discovered a remedy which bids fair to protect innocent wives and unborn children, besides many others in the community at large, from the horrible curse of syphilis.

"20. They have discovered a vaccine against typhoid fever, which among soldiers in camps has totally abolished typhoid fever, as President Taft has so recently and so convincingly stated. The improved sanitation which has helped to do this is itself largely the result of bacteriologic experimentation.

"21. They are gradually nearing the discovery of the cause, and then we hope of the cure, of those dreadful scourges of humanity, cancer, infantile paralysis and other children's diseases. Who that loves his fellow creatures would dare to stay the hands of the men who may lift the curse of infantile paralysis, scarlet fever, and measles from our children and of cancer from the whole race? If there be such cruel creatures, enemies of our children and of humanity, let them stand up and be counted.

"22. As Sir Frederick Treves has stated, it has been by experiments on animals that our knowledge of the pathology, methods of transmission, and the means of treatment of the fatal 'sleeping sickness' has been obtained and is being increased.

"23. They have enormously benefited animals by discovering the causes and, in many cases, the means of preventing tuberculosis, rinderpest, anthrax, glanders, hog cholera, chicken cholera, lumpy jaw, and other diseases of animals, some of which also attack man. If suffering dumb creatures could but speak, they, too, would pray that this good work should still continue unhindered."

On the other hand, what have the foes of experimentation achieved?

"1. Not a single human life has been saved by their efforts.

"2. Not a single beneficent discovery has been made by them.

"3. Not a single disease has been abated or abolished by them, either in animals or man.

"4. All that they have done is to resist progress—to spend $500,000 in 30 years in Great Britain alone, and very large amounts of money in the United States—and to conduct a campaign of abuse and gross misrepresentation.

"5. They apparently care little or nothing for the continued suffering and death of human beings, the grief and not seldom the ensuing poverty of their families, provided that 26 out of every 1,000 dogs and cats, monkeys and guinea pigs, mice and frogs experimented on shall escape some physical suffering.

"6. They insist, therefore, that all experimental research on animals shall stop, and—astounding cruelty—that thousands of human beings shall continue year after year to suffer and to die."

ACHIEVEMENT OF THE MEDICAL CORPS OF THE ARMY IN PREVENTIVE MEDICINE.

A VINDICATION OF ANIMAL EXPERIMENTATION.

By

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I have been asked to discuss animal experimentation in its relation to the advances that have been made in preventive medicine through the work of military surgeons.

It is not my intention to approach this subject in a controversial way, as I feel that the scientific achievements of the Medical Corps of the Army offer, in themselves, an argument that is incontrovertible. I shall endeavor to outline briefly two of the more important problems that have been solved, leaving entirely to your judgment the question as to whether they have contributed to the safety, happiness, and prosperity of mankind.

In considering the relation that animal experimentation—and laboratory methods in general—bears to great sanitary triumphs, one must remember that no great achievement has been the work of one man or of one institution. To Marshal Foch has been attributed the remark that "battles are won with scraps." This applies equally in the field of preventive medicine. Magendie, the great French physiologist, likened himself to a chiffonier—a rag-picker—wandering through the realms of science, picking up fragments of knowledge, piecing them together and applying them to his own problems as he went along.

Many times the observations of clinicians at the bedside or of epidemiologists in the field furnish the clue that leads to some epoch-making discovery in the laboratory; while, au contraire, in innumerable instances the truths elucidated in laboratories, applied practically by sanitarians and clinicians, have resulted in the conquest of disease.

Now let us see what has been accomplished.

TYPHOID FEVER.

The great scourge of armies during the nineteenth century was typhoid fever. At the beginning of the Franco-Prussian War, the infection existed in every corps of the German Army and was epidemic in at least one division. After mobilization the disease spread like wild-fire, especially among the troops besieging Metz and Paris. Within two months after mobilization typhoid had spread so rapidly among some of the German troops that one man out of every six

was sick of this disease. The total cases of typhoid in the German Army during that war was 73,396, or nearly 10 per cent of the average strength.

In the Afghan War of 1878-80 typhoid fever developed at nearly every station occupied by British troops, although some of these regions were practically uninhabited.

During the Oran campaign, in 1885, the French troops camped in desert stations never before occupied, and yet typhoid fever not only occurred, but the outbreaks assumed the proportions of alarming epidemics.

Many similar instances might be cited where troops were furnished drinking water of unimpeachable quality and occupied ideal camp sites that could not possibly have been typhoid polluted previously, yet typhoid invariably occurred.

The only explanation of such outbreaks is that an army carries its typhoid with it in the form of mild undetected cases, or of the so-called "healthy carriers" of the disease—individuals who have had typhoid and recovered, but who still harbor and excrete from their intestinal tracts virulent typhoid germs capable of investing others. The infection is then passed on from man to man by direct or through some intermediary—the usual intermediaries being, as we now know, "food, fingers and flies."

In our Civil War the army suffered severely from typhoid, especially the Army of the Potomac. In the four years between July 1, 1862, and June 30, 1866, there were 57,400 cases, resulting in 5,360 deaths.

Another tragic page in medical history is that of typhoid fever in the Spanish War. Every regiment constituting the First, Second, Third, Fourth, Fifth and Seventh Army Corps developed the disease. More than 90 per cent of the volunteer regiments were heavily infected within eight weeks after going into camp. Typhoid was almost equally prevalent in some of the regular regiments. The disease occurred in small camps as well as large, and in the north as well as in the south. There were 20,738 cases in a little army of 107,973 men; nearly one-fifth of the army contracting the disease. The toll paid to typhoid in that war was 1,580 lives, or 86 per cent of the mortality from all causes. Had the war been a real one with a powerful enemy at our doors, military effort would have been largely frustrated, we would have been subjected to invasion and perhaps ultimately to defeat.

Remembering that what has just been said applies to armies in the pre-vaccination days, let us pass on for a moment to a brief consideration of the development of preventive inoculation against typhoid fever.

From the discovery of the typhoid bacillus in 1880, and its successful cultivation in artificial media by Gaffky, a Prussian army surgeon, in 1884, the investigation of methods for the control of typhoid

fever have been greatly advanced by the work of army surgeons; the whole matter of protective inoculation—experimental and applied—having been elucidated for the most part in armies.

Widal, a French army surgeon, working with Chantemesse in 1888, first demonstrated that white mice could be made immune to the pathogenic effects of the typhoid bacillus by previously inoculating them beneath the skin with sterilized cultures. Incidentally, while conducting these experiments, Widal discovered the phenomenon of agglutination of bacteria in immune serum—a reaction now bearing his name and of great value in the laboratory diagnosis of typhoid and other diseases.

Carrying further the work of Widal, Sir Almroth Wright, of Dublin, Ireland, a British Army officer and professor of pathology at the Army Medical School at Netley, after much preliminary experimental work on laboratory animals, demonstrated for the first time, in 1896-97, through the results obtained in the experimental inoculation of over 3,000 soldiers in India, that vaccination of man was practicable. During the following three years the lessons were applied practically in the preventive inoculation of the British troops in South Africa.

In 1909, preventive inoculation against typhoid was introduced in our army by Major (now Colonel) F. F. Russell, Medical Corps. He went to Europe, studiously investigated the French, British and German methods in vogue at the time, and, returning to the Army Medical School in this city, organized and established a vaccine laboratory, in which all the vaccine since used by our army has been prepared. Each batch of this vaccine is carefully tested for sterility by injection into mice, and its immunizing properties are ascertained by the inoculation of rabbits. These animals are indispensable to the standardization of the vaccine.

At the beginning vaccination was voluntary—the first volunteers being officers and enlisted men of the Medical Department—and only a part of the entire army was vaccinated during this period. It was first made compulsory for the 20,000 men mobilized at the Maneuver Division at San Antonio, Texas, in the spring of 1911. During the months that these 20,000 men lived under war conditions there were but two cases of typhoid fever among them—one occurring in a non-vaccinated civilian teamster and the other in a Hospital Corpsman, who confessed to me while ill that he had only received one of the three inoculations prescribed, and that he had evaded the remaining two by falsifying the records. Following this conclusive demonstration of the efficacy of protective inoculation the procedure was made compulsory for the entire army in 1912. In 1909 there were 173 cases of typhoid in the army, while in 1912, the first year that inoculation became uni-

versally compulsory, the statistics dropped to nine cases with a single death. The peace-time army from then on remained practically free from typhoid.

Now we come to the recent World War. Let us consider the statistics of the American Army, now protected by anti-typhoid vaccination. Prefacing these statistics, however, I desire to bring home the fact that, with the exception that these troops had been immunized by protective inoculation, conditions favoring the development of typhoid were exceedingly comparable to those existing in the Spanish War. The army was composed almost entirely of troops hastily drafted from civil pursuits—comparable to the volunteers of 1898—and the citizen soldiers of the National Guard. They were hastily mobilized and sent to camps, many of which geographically were in close proximity to the plague spots of '98, and in many instances adequate sanitary arrangements had not been completed before the arrival of troops.

That portion of the army that subsequently went to France suffered great overcrowding for many days in improvised transports, and, upon arrival at ports of debarkation, were herded into box cars and rushed to the front. The earlier troops, during the fall of 1917 and winter of 1917-18, were billeted in insanitary surroundings, the condition of which can be appreciated only by those who were there. I remember the very amusing incident of a French peasant woman indignantly demanding that the American soldiers billeted in her barn be removed as they talked at night and kept the sheep awake. The proximity of outhouses to water supplies may be imagined from the request made by the peasants in another locality that the Americans interdict the use of disinfectants in their latrines as this procedure imparted a disagreeable taste to their drinking water.

The conditions in the trenches would have been a sanitary reproach had it been possible to correct them. Later, as trench warfare developed into open battles of movement, the troops at times lived under sanitary conditions that are indescribable. At Chateau-Thierry, for example, our troops moved into territory just evacuated by the retreating Germans that were nasty beyond description—dead bodies, dead horses, pools of feces and myriads of flies. In the Argonne, transportation difficulties, the nature of the terrain, and the dispersion of troops often made it impossible to furnish properly treated water at all times, and the troops drank from stagnant pools, collections of water in shell holes and whatnot.

Nor were the troops stationed in towns in the rear free from danger of infection. Systematic bacteriological examination of the water supplies in various parts of France showed that over 80 per cent of these were polluted and not fit for drinking purposes without previous chlorination or boiling. In many instances the water was veritable sewage and could not be used even after treatment.

Yet, during the two years of the World War, in which approximately 4,000,000 men served in the Army, half of whom saw service in France, there were but 1,065 cases of typhoid fever. In the Spanish War there occurred one case of typhoid among each six men; in this war one case in every 3,756 men. The official statistics of the Surgeon General's Office for the period September 1, 1917, to May 2, 1919, show that there were but 213 deaths from this disease. Had the death rates of the Spanish War prevailed, 51,133 deaths would have occurred, and had the Civil War rates applied, 68,164 lives would have been sacrificed.

We of the Army Medical Corps are thrilled with pride at this achievement of one of our colleagues. The mothers, wives, sisters and sweethearts of the 50,000 men whose lives were saved by anti-typhoid vaccination should breathe a prayer thanking God that there was a Russell—and animal experimentation.

These are the results of preventive inoculation against typhoid fever. I ask you, do they compensate for the lives of the laboratory animals sacrificed experimentally in perfecting this procedure?

Yellow Fever.

Perhaps the most spectacular achievement of the Medical Corps of the Army is the epoch-making discovery of the transmission of yellow fever by the mosquito.

Yellow fever, peculiarly a disease of the American continent, is one of the most fatal to which the human race is subject. The early colonists suffered severely from this disease, and it had an important bearing upon colonization in the Western Hemisphere. Its ravages in tropical America made this section a veritable plague spot for white men, resulting in the settlement and development of the temperate regions rather than the tropics. Untold agricultural and mineral wealth was diverted from the world's markets for 150 years by this grim reaper of human lives. As Vaughan so graphically states, "A certain dread and romance attaches to its history."

Formerly the disease existed perpetually in Havana, and from there it made frequent devastating incursions into the United States. Outbreaks occurred along the eastern seaboard as far north as Boston. It wrought its greatest havoc, however, in the Southern cities, where, during the great epidemic of 1878—only 42 years ago—16,000 persons died, and the economic loss was estimated at $100,000,000. This catastrophe focused public attention for a time and resulted in the birth of a National Board of Health to protect the United States from another invasion.

As most of the epidemics that had visited the United States were imported from Havana, it was evident to sanitarians that great pro-

tection would be afforded the United States were it possible to eradicate yellow fever at its source. The opportunity so long desired arrived when Havana came into our possession in 1898.

At this time nothing was definitely known as to the cause of yellow fever, or the means of its transmission. Sanarelli, an Italian doctor, had just announced the discovery of an organism which he called Bacillus icteroides, and he claimed it as the specific cause of this disease. Immediately keen interest was evinced in this discovery, and General George M. Sternberg, Surgeon General of the Army, himself a pioneer investigator in yellow fever, who had paved the way for subsequent workers, appointed an Army Board, consisting of Maj. Walter Reed and Dr. James Carroll, to investigate and report upon the relation of bacillus icteroides to yellow fever. This was in 1897. Reed and Carroll, through numerous experiments on swine and other animals, proved conclusively that Sanarelli's bacillus is a variety of the common hog cholera bacillus and has nothing to do with yellow fever.

In 1899, when yellow fever appeared among the American troops stationed in Havana, Reed and Carroll again, with Drs. J. W. Lazear and Aristides Agramonte, constituted a commission sent to Cuba to investigate its cause and transmission.

Shortly after arrival Reed was afforded an opportunity to study an epidemic of yellow fever among our troops at Pinar del Rio, and he became convinced, through his observations there, that the theory then governing all preventive measures, that transmission occurred through infected utensils, clothing, bedding, etc., was erroneous. He determined to give up, for the time being, further search for the specific cause of the disease and to devote all his efforts to the immediate pressing need of the elucidation of the means of transmission in order that effectual preventive measures might be instituted.

The belief that the disease was transmitted by mosquitoes, expressed by Dr. Carlos Finlay, of Havana, nearly twenty years before, appealed to Reed as the most logical theory to investigate. The only way of proving or disproving this theory was to permit infected mosquitoes to bite susceptible persons as laboratory animals were thought to be immune. After weighing the terrible responsibility of carrying out such experiments on human beings, the commission decided that if they succeeded in transmitting the disease experimentally through mosquitoes, the benefit to humanity would justify the hazard. They agreed, however, that in justice and fairness they themselves should be included among the volunteers.

Female mosquitoes of the variety known as stegomyia fasciata were obtained from Dr. Finlay, infected by feeding on patients acutely ill with yellow fever, and then applied to the volunteers. The first experiments were carried out by Lazear as Reed had been recalled

temporarily to the United States. Lazear's first attempt to infect himself was unsuccessful. Later he was bitten by a mosquito while collecting blood from a patient in a yellow fever ward, and he purposely permitted the mosquito to take his fill. Several days later he became ill of yellow fever and died. In the meantime Lazear had applied infected mosquitoes to Carroll, and this resulted in the first successful experimental inoculation. It can best be described in the words of Carroll himself:

"The insect, which had been hatched and reared in the laboratory, had been caused to feed upon four cases of yellow fever, two of them severe and two mild. The first patient, a severe case, was bitten twelve days before, the second, third and fourth patients had been bitten six, four and two days previously, and their attacks were mild, severe and mild, respectively. In writing to Dr. Reed on the night after the incident, I remarked jokingly that if there were anything in the mosquito theory I should have a good dose; and so it happened. After having slight premonitory symptoms for two days, I was taken sick on August 31, and on September 1, I was carried to the yellow fever camp. My life was in the balance for three days, and my chart shows that on the fifth, sixth and seventh days my urine contained eight-tenths and nine-tenths of moist albumin. On the day that I was taken sick, August 31, 1900, Dr. Lazear applied the same mosquito, with three others, to another individual who suffered a comparatively mild attack, and was well before I left my bed. Thus it happened that I was the first person to whom the mosquito was proved to convey the disease. On the eighteenth day of September, five days after I was permitted to leave my bed, Dr. Lazear was stricken and died in convulsions just one week later, after several days of delirium with black vomit. Such is yellow fever."

This experiment on Dr. Carroll was followed by eleven others, nine of which were negative and two positive, and, upon this evidence Reed felt justified in pronouncing, without hesitation, that "the mosquito acts as the intermediate host for the parasite of yellow fever."

The experiments did not stop here, however. The idea of mosquito transmission was contrary to what a great many men believed, and it aroused a storm of adverse comment and criticism. Reed and his colleagues decided, therefore, to repeat and simplify the experiments under conditions that would leave no doubt as to their conclusiveness. They established an experimental station, a mile removed from the nearest habitations, and surrounded it with an armed guard. No intercourse was permitted with the town except through an immune ambulance driver and an immune hospital steward who transported supplies from Camp Columbia. The personnel and such susceptible individuals as were admitted for experimentation were sheltered in tents placed twenty feet apart. This station was named Camp Lazear.

A small frame building was built, 14 x 20 feet, so screened with wire netting that mosquitoes could not get in or out. The interior of the building was divided into two compartments by a partition made of wire netting running down the center. Two susceptible persons were put in this building—one in each compartment. Breathing the same air and subjected in every way to the same conditions; but entirely separated by the wire netting, they lived and slept in these compartments for several days to show that there was no yellow fever infection in the building. Reed then put fifteen infected mosquitoes in one of the compartments, left a man in the compartment for thirty minutes, and announced that this compartment was now infected. He took the man out of this infected compartment, but left two men in the compartment on the other side of the wire netting. The man from the infected compartment returned for twenty minutes in the afternoon of the same day, and again, for fifteen minutes on the following day. During these three visits he was bitten by mosquitoes fifteen times. At the end of the fourth day the man from the infected compartment was down with yellow fever and the two men who had remained in the other compartment separated only by the wire netting and breathing the same air, were perfectly well.

Reed then announced that he would disinfect the infected compartment simply by catching and removing the fifteen mosquitoes. Following the removal of the infected mosquitoes a nonimmune soldier was again placed in each compartment, left there several days and they remained perfectly well.

Although the experiment created a profound impression and the skeptics now admitted that the disease could be transmitted by the mosquito, they still maintained that it could be, and generally was transmitted in other ways, such as by soiled clothing, bedding, and by contact with persons sick with the disease, etc.

Reed then had constructed another small building that was almost air-tight—practically devoid of ventilation. In this building he placed material from the yellow fever hospital at Las Animas—mattresses on which yellow fever patients had died, sheets, pillows and piliow cases liberally smeared with black vomit, excreta and discharges; and even the pajamas worn by yellow fever patients throughout their illness. This material was opened up and spread out in this close room, and Reed asked for volunteers to sleep in the room. Dr. R. P. Cook, of the Army, and several soldiers responded. These men wore the pajamas mentioned and slept on the bedding for twenty consecutive nights. All the men remained well—not a single case of yellow fever developed from this exposure. This demonstrated, once and for all, the fallacy of the filth or fomites theory of the transmission of yellow fever. The experiments were generally accepted as proving beyond question that

yellow fever is conveyed from man to man by the mosquito alone and in no other way.

The Board conducted further experiments demonstrating that the virus of yellow fever exists in the patient's blood only during the first three days of the disease; that the virus is ultramicroscopic, being capable of passing through a porcelain filter that holds back ordinary bacteria, and that it is killed by a temperature of 55° C. in ten minutes. They also showed that the female mosquito, only, can convey the disease; that after biting an infected person a period of twelve to twenty days must elapse before the mosquito is capable of transmitting it to another; and that following the bite another period of from three to six days elapses before the patient develops the disease.

These experiments are the foundation upon which all sanitary campaigns against yellow fever are now based. Let us now consider what they have done for humanity.

For nearly two years prior to the conclusion of Reed's experiments the Army had been in entire control of sanitary affairs in Havana. Our cleverest sanitarians, among them Victor C. Vaughan, of the University of Michigan, probably the foremost American epidemiologist, had failed dismally in controlling yellow fever by means of methods based on the filth theory of disease.

Following Reed's demonstration that the disease is transmitted solely by the mosquito, the sanitarians paid no more attention to fomites, but proceeded to apply practically Reed's experimental evidence in the following ways: (1) A strict quarantine was established to keep infected persons from entering the city. (2) A daily inspection of all nonimmune persons was made in order to detect new cases during the first three days of the disease—the only period, you will remember, during which the virus is in the blood. (3) All persons sick of yellow fever were immediately screened and isolated so that mosquitoes could not bite them. (4) A vigorous antimosquito campaign was instituted aiming at the destruction of all mosquitoes—killing the insects in habitations by wholesale fumigation and energetically searching out and doing away with their breeding places.

Considerable effort, anxiety and experimentation were extended in perfecting the methods, but on September 26, 1901, seven months after the institution of these methods, the last case of yellow fever occurred, and Havana was free from this disease for the first time in 140 years. During that 140 years not a single month had passed without a death from yellow fever, nor had there passed a day in which there had not been some person sick of yellow fever within the city.

Conquest of Yellow Fever in Panama.

Soon after the conquest of yellow fever in Havana, our Government began outlining plans for one of the greatest, if not *the* greatest

engineering project in history—namely, the construction of the Panama Canal.

Early in 1902, while still stationed in Havana, where he had directed the sanitary work that had rid the city of yellow fever, Major (now Major General, retired and recently Surgeon General) William C. Gorgas, of the Medical Corps, invited General Sternberg's attention to the enormous loss of life from tropical diseases that had occurred among the French while working at Panama; emphasized the fact that these fatalities had resulted for the most part from yellow fever and malaria; and suggested that the methods that had been so effective in Havana, if carried out in Panama, would greatly reduce the mortality that might be anticipated among American workers on the Isthmus. General Sternberg concurred in this opinion and recommended that Major Gorgas, on account of his previous experience in Havana, be placed in charge of the sanitary work in Panama.

The contemplated route of the Panama Canal lay through a low, swampy, densely vegetated country, alternating with rugged mountainous regions, where the rainfall was excessive and yellow fever and malaria prevailed to an alarming extent.

The French attempt, in the eighties, to unite the waters of the Atlantic and Pacific by this isthmian route, although directed by one of the greatest engineering geniuses of all time—Ferdinand de Lesseps—had to be given up because of the enormous price paid in human lives. The French lost 22,189 laborers by death and sunk millions of dollars. It is said that the price paid in building the old Panama railroad was a human life for each tie laid. One of the towns on this railroad was named Matachin, from the Spanish words meaning "dead chinaman," because a thousand imported Chinese laborers and a thousand African negroes laid down their lives at this point in six months. Colon at one end of the Canal was a veritable white man's graveyard; while the town of Panama at the other end bore the unsavory reputation of being the plague spot of the universe There was poverty, there was vice, there was every noisome thing that crawls and creeps. There were pestilences, and the greatest of these were yellow fever and malaria—another mosquito-borne disease.

Then came Gorgas with his trained corps of sanitarians—fresh from their victory in Havana. The story of the sanitation of Panama under the administrative direction of Gorgas is a long one, and I shall not bore you with details. Suffice is to state that by instituting sanitary measures similar to those used in Havana—destroying mosquitoes, making habitations and hospitals mosquito-proof by screening, isolating all suspecting cases of yellow fever and malaria, removing underbrush, filling and obliterating stagnant pools and swamps, paving and guttering streets, and installing sanitary water supplies and sewerage systems, Gorgas entirely eradicated yellow fever within a year, and

there has not been a single case of this disease in the Canal Zone since May, 1906. Coincidentally with the disappearance of yellow fever there was a drop in the incidence of malaria. At the beginning of this great sanitary campaign 800 cases of malaria occurred annually in each thousand workers. By 1913 the rate had been reduced to 76 per thousand. The general annual death rate in the Canal Zone from all diseases at the present time is about 20 per thousand—a figure comparing very favorably with that of New York or Washington.

The work of Gorgas alone made possible the building of the Panama Canal. But this is not the greatest benefit derived from that tremendous task, so spectacularly and effectively accomplished. By salvaging the Isthmus of Panama through sanitation the great lesson learned is that the tropics can be made as habitable for white men as the temperate zone. How different would have been the history of the Americas had it been learned 300 years earlier.

In contemplating this—the greatest achievement of modern times—let us not forget Walter Reed—and experimentation.

The triumphs over typhoid and yellow fevers have not been the only scientific achievements of the Medical Corps of the Army. Did the time allotted to me permit I would tell you of the work of Sternberg, the first American bacteriologist, discoverer of the diplococcus of pneumonia, pioneer worker in yellow fever, author of important treatises on infection, immunity and disinfection, founder of the Army Medical School, and a former surgeon general of the Army; of the demonstration by Ashburn and Craig that dengue fever is due to a filterable virus and that it is transmitted by the mosquito and amenable to prevention by the methods successfully used in malaria and yellow fever; and of the work of Chamberlain and Vedder, who, by experiments on fowls, disarmed the tropical disease beri-beri—tearing from it its mysticism, robbing it of its terrors and placing it in the category of curable as well as preventable diseases.

The conquest of hook-worm disease in Porto Rico, work based largely on the demonstration by experiments on animals that the parasite enters the body through the skin, is the work of Bailey K. Ashford, a medical officer of the Army and a graduate of your own university—Georgetown.

Many other instances might be enumerated of scientific endeavor redounding to the benefit of humanity. Those cited, however, should be sufficient to show that all advances in preventive medicine have their basis in experimentation—on animals as a rule, but on men when necessary and justifiable.

Without animal experimentation we must inevitably stagnate, and many pressing questions as to the cause and prevention of devastating epidemics of transmissible diseases—influenza is one of these—must remain unanswered.

I submit to you—shall animal experimentation be prohibited or no?

THE LABORATORY WORK OF THE UNITED STATES PUBLIC HEALTH SERVICE.

By

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In an attempt to familiarize you with some of the laboratory researches of the U. S. Public Health Service, I find it necessary to select certain illustrative examples from an almost endless list. The Public Health Service did not launch into existence on any definite date, save in name. Its development was gradual. From time to time as the emergency arose, Congress assigned it new duties and granted it further power. The purpose of the Service in genera! may be stated to be the promotion of public welfare by conserving and improving the health of the inhabitants of the country. In order to carry out intelligently and efficiently the duties laid upon it by law, the Service has had to engage in a great deal of laboratory work. In the course of this work it has been absolutely essential to use the lower animals.

Before taking up in detail a discussion of the particular functions of the Service, it is necessary to make clear what is meant by "the experimental method." If we review the works of the ancients, we find that there was no lack of intellectual acumen among them; in literature and in the arts they give abundant evidence of high mental powers. Why was it, then, that in matters of science they made very little progress, and that for centuries medical science especially was in a state of almost complete stagnation? The difference, I believe, is readily traceable to the lack of proper methods. Just as in mathematics the lack of the calculus prevented the solution of a certain mathematical problem, so in the physical sciences the lack of the experimental method effectually barred the door to progress. We can easily imagine that primitive man was satisfied with the explanation of a thunderstorm that it was due to a combat between devils fighting above the clouds. His explanation of disease was akin to this with the one exception that the conflict was limited to his own interior. In ancient India the Brahmins have accumulated some very interesting anatomical information; for example, they stated that in the human body there are 100,000 vessels, each divided into seven tubes, which carry ten different kinds of gases to all portions of the body. Moreover, the origin of the pulse they located in the abdomen; it was said to be two hands high and three hands wide, and from it little tubes radiate to all parts of the body. When Greece was in her prime her philosophers had elaborated a most intricate system of medical doctrine; indeed, their theories curried favor far down into the period following the Rennaissance. Disease was due to the conflict of various humors and spirits which circulated throughout the body. It will be noted that all of the philos-

ophers up to this time had approached disease from a purely theoretical standpoint. Investigation on the body by dissection and experiment had been resorted to very rarely and very superficially, and the practical knowledge of the prevention and cure of disease was, to all purposes, negligible.

Let us contrast this mode of introspective philosophy with the method used by William Harvey, discoverer of the circulation of the blood. This great scientist, who was one of the earliest to use the experimental method in its perfection, actually dissected the body of man and of the lower animals; he conducted experiments on the living bodies of animals, and only after he had carried on his investigations for more than ten years did he venture to make public the results. These findings were so at variance with the accepted doctrines which had been handed down from the Greeks that Harvey was derided and maligned, but it is gratifying to note that within his own lifetime his views were accepted and his practices emulated. The remarkable progress of recent years in the medical sciences is directly traceable to the methods of experimental investigation introduced by William Harvey and other men of courage who were unwilling to sponsor unsupported tradition and who had to see with their own eyes before they tabulated conclusions.

The U. S. Public Health Service has, of course, found much of its information concerning disease ready made. Other data it has established by experimental methods, and it is important to see that not only in beginning work related to public health is it necessary to use information gleaned from experimental methods involving the use of animals, but that in the actual continuation of the work after routine fashion, it is imperative to rely upon the same.

Bubonic Plague.

I have selected as the first illustration of the laboratory work of the Service its operations in connection with a disease which probably has solicited the attention of but very few persons in this audience. Bubonic plague, to the average person, is looked upon as a distant, tropical, exotic disease little to be worried about, and my reason for selecting it is the fact that were it not for the employment of methods which were learned from experimentation this plague might very well be in our midst today. Daniel Defoe has handed us a pen picture of a plague epidemic in London; that this was not overdrawn has subsequently been proven by many historic recurrences. Fancy a city distracted, the inhabitants rushing about in a frantic effort to escape the pestilence, only to be met at the borders of the city by armed guards stationed to prevent their exit; unburied bodies line the streets and abandoned children are left to starve; traffic and commerce is disorganized, famine follows close upon pestilence. Such occurred in the days before science pointed out the cause of the plague and of its

spread and suggested a rational, effectual mode of combating the disease.

At the present time there is an infection of this plague in one of our larger American cities, yet no panic reigns, tourists visit the city in large numbers, and all is apparently prosperous. This because there is constantly being carried on in that city a quiet, effective campaign to meet the emergency. The experimental investigations have shown that plague is essentially a disease of rats; that it is conveyed from rat to rat, and may be communicated from rat to man through the flea. With this known it is found to be practicable to prevent the spread of plague by systematic examinations of rats captured in all portions of the city. When a plague rat is trapped intensive antirat operations are carried on at the place where this rat was apprehended, and thus an incipient focus of plague infection is wiped out before gaining headway. The claim that general methods of sanitation will effectually prevent plague epidemics is unsubstantiated; they merely limit rat infestation.

Diphtheria.

Turning now to a disease more familiar to us I shall review the work of the Service on diphtheria. Diphtheria continues to be prevalent, chiefly because the germ which causes it may be carried about in the noses and throats of perfectly healthy persons. Since it is impossible to examine an entire population in order to discover who these so-called "carriers" are, and since it would be impossible to quarantine them all when apprehended, the efforts of health officials have been only in part successful toward eliminating the disease, but by methods which were devised by animal experimentation it is possible to reduce the death rate from this disease to a very favorable figure. For example, the method of making an early diagnosis by laboratory methods has enabled us to treat cases earlier and more effectually and to prevent infection of those who associate with these cases. Diphtheria antitoxin also is one of the most remarkably efficient remedies known to man. But suppose no supervision were exercised over the manufacture of this antitoxin, and that inert and worthless samples of the product were freely marketed, we can readily estimate how many lives would in consequence be sacrificed. The Public Health Service controls the manufacture of antitoxin, making sure, by methods of animal experimentation, that this product as it is sold in the drug store is potent and reliable. Furthermore, by animal experimentation a method has been devised for examining the bacteria which cling to the throats of patients following their convalescense to determine whether they are dangerous to others or not.

Serums and Vaccines.

The Service supervises in like manner the commercial production of many other serums and vaccines which are used for the treatment of

various diseases. I may mention in this connection the serum for tetanus, or lockjaw, through which many a soldier in the trenches was saved to the nation. Typhoid vaccine, a product of great efficiency, is standardized by methods in which animals are used; rabies vaccine more familiar known as the Pasteur treatment for Hydrophobia, is prepared by the Service, and its preparation necessitated the use of animals. This list might be prolonged indefinitely, but it is safe to say that there is scarcely any useful product of this general class which has not necessitated the experimental use of animals, either in its discovery, in its preparation, or in its standardization.

At the present time there is being conducted throughout the United States an energetic crusade against veneral disease. While these diseases involve a moral problem for all, to the sanitarian they present also a purely medical problem. Hence it is essential that every person known to be infected from syphilis should be treated to prevent his being a menace to those with whom he may come in contact. To effect this arsphenamine is preeminently efficient. The preparation of this substance is difficult, and, unless the greatest care is taken, a product may be issued for distribution which is unduly poisonous and would, if administered to patients, beget most disastrous results. The Public Health Service is charged with the duty of examining each batch of this substance offered for sale. To do this the lower animals must be used.

From time to time reports reach the Bureau of the U. S. Public Health Service of the occurrence, in this or that part of the country, of a new or rare disease. This calls for an immediate investigation to ascertain whether this condition is likely to spread and become serious, of possibly to end in a nation-wide menace. Such have been pellagra, Rocky Mountain spotted fever, the so-called "deer-fly disease," and a disease called after its discoverer, Dr. Brill. In nearly all of these instances it was imperative to make extensive inoculations of animals in order to determine the nature and cause of the disease, to find out what animals beside man might be afflicted with it, and, in some instances, to devise a remedial agent. During the war a considerable number of cases of anthrax, or malignant pustule, occurred among soldiers, and an investigation, in which the use of animals became necessary, showed that these cases were due to a natural infection of shaving brushes through the hair from which they were made. Regulations were immediately issued to inhibit the use of harmful material in the manufacture of these articles.

Tuberculosis.

We have with us at all times a disease which is so common that we perhaps do not fully appreciate what a tax it entails on the economy, the health and the happiness of the populace; tuberculosis occurs actively in perhaps 1 per cent of the population and occasions at least

one out of every ten deaths. If this occurred in an isolated epidemic we should be appalled. Great as have been our advances in the knowledge of this condition, there remains much to be investigated and learned. We have been obliged to experiment upon animals in obtaining our present information and this practice will necessarily continue, if we are to find out more. The Service is at present engaged in an experimental investigation of tuberculosis with the view to discovering some method which will aid in the fight against this insidious malady. Every now and then a new and wonderful cure for tuberculosis is ushered in with much sound of trumpets and flaring headlines in the newspapers. Some of these so-called "remedies" are little less than unadulterated, heartless fakes; others are somewise bolstered by scientific plausibility; unless the public be informed by a reliable authority as to the true merits of these "cures" a most pitiable state of affairs is likely to transpire. Sufferers from all parts of the country, many of them in the last stages of the disease, many having spent their last cent for railroad fare, flock to the center where this new remedy is obtainable, only to share disappointment, and frequently to die from exhaustion. It is felt that the Service in investigating and furnishing the public with reliable information on the subject of certain of these reputed "cures" has rendered a valuable service to the country. In such investigations it is necessary to use experimental animals, as it is, indeed, in arriving at a diagnosis in many suspected cases of tuberculosis.

Other Problems.

Probably no drug is more freely prescribed in diseases of the heart than is digitalis. Yet unless this remedy is of a standard quality, it is apt to be harmful rather than beneficial. Accordingly, with the aid of animal experimentation, the Service has formulated a test which unquestionably establishes the strength and purity of the drug.

It has been recently estimated that there are perhaps a million persons in the United States who are addicted in some degree to the use of habit-forming drugs. The pernicious effect of these drugs on the individual himself and on the civilization of which he is a unit are well known; and yet there is a real need for the alleviation of pain and other symptoms of drugs which have an action similar to the habit-forming drug, but free from this distressing feature. Some progress has already been made in devising suitable substitutes, and in this work an indispensable factor has been the use of animals.

Those opposed to vivisection and, indeed, to animal experimentation generally, are accustomed to characterize many of the investigations carried out by scientific men as being due to idle curiosity. It is true that investigations are made into various phases of the disease problem without there being at the time any apparent way in which the information gained can be practically applied. Nevertheless, such information sooner or later is almost certain to merit its place in devising something of value to humanity. One instance, as an example of this, is anaphylaxis. If horse serum be injected into a guinea pig, even in large amount, it ordinarily provokes no appreciable effect, but an investigator noticed that if, after an interval of ten days or more, another injection of horse serum be given the same animal, it acts as an acute poison, often killing the animal within a few minutes. This finding invited the closest research. No immediate practical benefit to mankind was at first anticipated, but, as a matter of fact, the information thus gained has been of great value in diagnosing hitherto obscure disease conditions in man and in suggesting preventions and cures. Another example: During the examination of the bodies of rats for plague infection, a disease of quite different origin, but closely simulating plague in the lesions caused, was unexpectedly brought to light. Through animal experimentation the bacterium causing this disease was cultivated. No immediate bearing of this fact on human health or happiness could be foreseen, yet within a very few years it was discovered that many could suffer a distressing infection due to this same organism.

Problems regarding measles, infantile paralysis, hookworm and the like placed before this Service for solution might very profitably be called to your attention, but time forbids. In concluding I beg leave to advise you that the benefits which have accrued to man consequent to animal experimentation have touched not only physical but also his moral well being. It is true that vice predisposes to disease, but it is no less true that disease, innocently contracted, brands as a criminal one who otherwise would have been a useful citizen.

There so appears here a vicious circle between disease and criminality; there are those that would break the continuity of this circle in the reformation of all criminals, and we wish them well, but surely it is not a step toward the wrong if, with the means at our disposal, we, too, interrupt this closed line, ridding the community of the diseases, which, directly or indirectly, are responsible for a great part of it.

THE ECONOMIC ADVANTAGES DERIVED FROM ANIMAL EXPERIMENTATION

By

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The economic advantages derived from animal experimentation are so abundant and diverse that it is impossible in the time I am privileged to discuss them to do more than indicate their far-reaching importance. To verify this statement I need ask only a few questions like the following: Is it an economic advantage to have the Panama Canal? Is the defeat of Pan-Germanism an economic advantage? Is it an

economic advantage to have food and clothing in sufficient quantities to insure health?

The Standard Dictionary defines economics as "the science that treats of the development of material resources, or the production, preservation and distribution of wealth, or the means of living well for the state, the family and the individual."

If we accept this definition we may conclude that anything, not an actual, inseparable part of ourselves, that contributes to the better development of the human race and tends to make life more desirable, is an economic advantage; hence, the rational answers to the several questions must be affirmative.

The Panama Canal would not have been built if animal experimentation had not revealed the etiology of yellow fever. The French failed to build it, not because they lacked intelligence, courage or perseverance, but because they did not know how to combat the yellow fever. Under the same conditions the Americans would have failed. If the Canal had been constructed with no better knowledge about yellow fever than was available at the time the French abandoned the gigantic project, after they had sacrificed more than twenty-thousand lives, success would have cost so many valuable lives that the very thought of it is horror inspiring, and the established short-cut between the Atlantic and Pacific Oceans probably would have proved so perniciously unwholesome and destructive to those who used it that it soon would have earned a name for itself something like, "The water-lane of the yellow death."

What the Canal has done and promises to do in the conservation of man-power, time, shipping, fuel, etc., and how much it will facilitate the development of the world and particularly the countries on the western coast of the two Americas, I leave to your imagination.

If animal experimentation had not provided vaccines, bacterins and antitoxic sera; if it had not aided in the development of new methods of surgery and the discovery of reliable means to diagnose infectious diseases, and had not taught us how to use war gases and how to defend our soldiers against them, the recent war would have cost many additional thousands of lives and would have produced many additional thousands of cripples; it would almost certainly have been prolonged and it is seriously questionable whether Pan-Germanism, with its numerous, villainous atrocities, could have been defeated.

The economic significance of its prolongation, leaving morbidity and mortality out of consideration, may be judged from the estimate that the war cost the human race three hundred billion dollars, and about the economic meaning of defeat we should suspend judgment until we have tried to visualize the world under the domination of a victory-elated despot, whose megalomania, fostered by an exultant, reactionary, Prussian aristocracy, would have prompted him to assume the rank of a divinity.

If animal experimentation had not taught us how to cure many diseases of the lower animals and how to suppress appallingly destructive animal plagues, the hunger and starvation now prevalent in many parts of the world would be practically universal. I might say, however, if animal experimentation had not provided the means to control human diseases like small-pox, Asiatic cholera, bubonic plague, typhus fever, yellow fever, etc., it is not at all likely that the population of the world would have become great enough to make the spread of food-destroying diseases like rinderpest, foot and mouth disease, anthrax, Texas fever, hog cholera, surra, swine erysipelas, contagious pleuro-pneumonia of cattle, sheep, scab, etc., economically very important, as food has no value for those who are dead and those who fail to be born.

Vegetarians, who do not recognize the need for abundant supplies of meats, animal fats, wool and hides, and persons who hold extreme views on animal rights, may mistake this statement as an exaggeration. Their attention should be called to the fact that it is questionable whether sufficient food for the present population of the world could be produced without the use of animals to convert coarse, vegetable substances, unfit for human stomachs, into easily digested, nutritious food, and to the fact that, in addition to serving as indispensable sources of food, clothing, power and pleasure, domestic animals are so importantly, related to the production of vegetable foods and textile fibers that practical agriculturists are convinced that the cultivation of the soil without animals is economically impossible.

The spiritual and intellectual nature of man requires that we should look upon him as an unique and unparalleled being, but materially, that is physically and chemically, he is not fundamentally unlike the higher mammals; consequently, most knowledge valuable for the protection of man's health and the treatment of his diseases is similarly valuable for the lower animals, and discoveries, like the circulation of the blood; the capillary circulation; the vasomotor mechanism; the functions of the nervous system generally; the flow of the chyle in the lacteals and its passage through the lymph ducts into the venous circulation; the nature of the digestive fluids and the chemical transformation of food through their action; the functions of the liver, lungs, kidneys and other organs, the reaction of the cells to various kinds of stimuli; the significance of the endocrin glands; the nature of inflammation and other pathological processses, and practically every other discovery in physiology, pathology and biochemistry, are as serviceable in the work of the animal husbandman and veterinarian as in that of the hygienist and physician, and in this sense have great, material, economic value.

The discoveries referred to, and many others, too numerous to mention, were all made through animal experimentation, and could have been made in no other way that has ever been defined.

Veterinarians and physicians use drugs, and if the pharmacopoeia contains valuable drugs about which our knowledge has not been enriched through animal experimentation, I must confess that I do not know what they are. A superficial and insufficient knowledge of the actions of some drugs was admittedly obtained through accidental or unintentional, unguarded and undesirable occurrences among persons and animals, but the precise knowledge we have of the therapeutic, physiologic and toxic actions of the innumerable substances from which our useful drugs have been selected, is all the product of carefully planned, intelligent animal experimentation. If we did not know through animal experimentation how the drugs now in use act, on the body as a whole, on special parts of the body, directly or indirectly through the nervous system, and whether their action is immediate or cumulative, the death rate among persons and animals would be grievously multiplied, and the greater losses among the latter would prove a factor of serious, economic disadvantage.

Before experimental methods were used to study living organisms in health and disease, the practice of medicine was little better than a presumptive art, based on disconnected and largely misinterpreted observations, and sick persons and animals were tortured as often, if not oftener, than they were helped by the measures taken to restore their health. Since then, fortunately for all sentient beings, medicine has become a true science, and those who practice it make real, unmistakable contributions to recovery from sickness, the preservation of health and the prevention of suffering . In animal industry this means fewer losses and greater productivity, or, in other words, better and less expensive food and apparel.

I wish to emphasize that nearly every discovery that has thrown light on the nature of the human body and its relation to its environment has also thrown light on the nature of the bodies of the lower animals and their relation to their environment, as this fact enables us to recognize that even that portion of animal experimentation, primarily undertaken to secure knowledge for the prevention and better treatment of human disease, rarely fails to confer benefits on the lower animals; hence, if the proportion between the pain animal experimentation has caused and prevented among animals alone was taken as the major factor in determining whether animal experimentation is or is not morally sound, we would not be left in doubt a single moment, as the pain that has been caused is insignificant in comparison to that which has been and is being prevented. The men who treat diseases among animals probably relieve more pain every day than animal experimentation causes in a score of years, and they do this through the agency of the knowledge animal experimentation has supplied.

Diseases of animals like those of persons may be divided into two kinds, the infectious and the non-infectious, or those caused by parasites and those due to other causes. The economic advantages derived

from animal experimentation, through the light it has thrown on the infectious diseases of domestic animals, are of astounding value, and this can be shown in no better way than by discussing several of them separately.

I will begin with Texas fever of cattle, which has the distinction of being the first disease proved to attack its victims exclusively through the agency of intermediate host or carrier of its causative germ or microparasite. It is a member of a large group of exceedingly destructive, infectious but not contagious diseases; other members of the group are malaria, yellow fever, typhus fever, Rocky Mountain spotted fever, African sleeping sickness, spirillosis of fowls, nagana, African coast fever of cattle, piroplasmosis of horses and sheep and dogs, etc.

The intermediate host of Texas fever is the Southern cattle tick, a blood-sucking parasite which absorbs the germs of the disease with its food when it lives on the bodies of infected cattle. The female ticks, after they reach maturity, drop to the ground, produce two thousand or more eggs, the eggs hatch and the young ticks inoculate the susceptible cattle to which they attach themselves. It is perfectly safe to permit healthy cattle to associate with those that are affected with Texas fever, provided no cattle ticks are present, and cattle ticks do not convey or cause the disease unless they are the progeny of ticks that matured on the bodies of infected cattle. Infected cattle, when we deal with Texas fever, means all cattle that are either actively affected with the disease or that have apparently recovered from it, as the Texas fever microparasite, once it has entered the blood of cattle, evidently remains as a permanent contamination.

In one of the lectures of the present series, Dr. Simon Flexner of the Rockefeller Institute for Medical Research expressed the opinion that our knowledge of yellow fever would in all likelihood have been delayed if the work of the Bureau of Animal Industry of the U. S. Department of Agriculture on Texas fever had not been done. I have already pointed out that the Panama Canal would not have been constructed without the knowledge animal experimentation gave us on the etiology of yellow fever.

Think of the modest investigator whose patient study of a mysterious cattle disease proved a great pioneer work in the field of medical research, and incidentally opened the door to knowledge required for the junction of two oceans at a point thousands of miles removed from where nature permitted their waters to mingle. Draw a mental picture of the man and his work; it will give you an inspiring view of intellect successfully combatting evil. But it is unnecessary in speaking about Texas fever to dwell longer on the rôle of animal experimentation in the accomplishment of a great engineering feat, as there are other impressive and exceedingly important things to

talk about in connection with this disease that must also be credited to animal experimentation.

Less than fifteen years ago the prevalence of Texas fever and cattle ticks in our Southern States necessitated the maintenance of a cattle quarantine which included an area larger than three quarters of a million square miles, known as the permanently infected area. In this area, more than three and one-half times as large as the French Republic and nearly three and one-half times as large as the former German Empire, the losses caused by Texas fever and its carriers were enormous, to say nothing about the frequent, troublesome spread of the disease northward. Most of the cattle raised were undersized, large-boned, unthrifty mongrels and inferior producers of milk, meat and hides. Much of the food they consumed was worse than wasted, as it was diverted from sharing in their growth and development, after their bodies had been taxed with digesting and converting it into blood, to feed the ticks which irritated the surfaces of their bodies and the microparasites which lived beneath the surface.

A fairly reliable idea may be formed of the losses caused by ticks alone when we know that female cattle ticks multiply their size and weight by about ten-thousand during the approximately four weeks they remain attached to the skin and feed on the blood of their hosts; that the adult female tick is about as large as the terminal joint of a woman's little finger, and that ticks of all ages and sizes, often in unbelievable numbers, are present on the bodies of the cattle in the infected territory during the greater part of the year.

A light infestation with ticks has been proved to reduce the milk yield of dairy cows 18%, and a heavy infestation reduces it more than 40%. Think of the loss, to which must be added the loss in beef production, the lower value of roughened and scarred hides and the deaths due to Texas fever, which latter, averaged for eleven states, amounted to 13%, or a half per cent more than one-eighth of the total cattle. The reason cattle could be raised at all in the infected and infested territory is that Texas fever in calves rarely is the severe, acute, highly fatal disease it commonly is in susceptible adult cattle. It attacks the calves, has a mild, chronic course, plants its microparasites permanently in their blood and gives them a high degree of immunity against severe attacks later on.

Agriculture may be compared to a complex machine; there are many parts to it, and if one part gets out of order all the others are affected. The cattle industry is as necessary to American agriculture as tires are to an automobile, and to practice agriculture with cattle ticks, Texas fever and a cattle quarantine, resembles driving an automobile over a rough road, littered with cutting and puncturing objects and undergoing constant repairs that require long detours. Hence, it is not surprising that agriculture in many parts of the quarantined area was

unprosperous and that the farmers and breeders were discouraged and depressed.

In the year 1906, the methods for eradicating Texas fever and cattle ticks, revealed through animal experimentation, were put into practice by the U. S. Bureau of Animal Industry, and since then, over half a million square miles, a territory one-hundred thousand square miles larger than the combined areas of the French Republic and the former German Empire, have been cleaned of the disease and its carriers and released from quarantine, and in only a few years more the two related plagues will have been wiped entirely out of our Country.

Fully to appreciate what this means, and to measure its economic value, we must know that the formerly infected and infested, quarantined territory includes some of the best agricultural and cattle lands in the world, and that it has begun to produce cattle that compete successfully, and on terms of equality, with the finest that enter our stockyards, and that recently it has produced cattle that captured blue ribbons at National livestock shows. The farmers and breeders have taken heart and are working with renewed courage, and increased prosperity and contentment are widely evident. The choice, well-bred, healthy, heavy and profitable cattle are being produced at no greater expenditure of labor and forage than the undersized, suffering runts required, as cattle raising and feeding has ceased to mean raising and feeding a combination of cattle, cattle ticks and Texas fever parasites. It is now safe to send cattle from the North into the rich pasture lands of the South, where, a little while ago, it was unsafe, notwithstanding difficult precautions, to send thoroughbred animals for breeding purposes.

Think of the economic advantage. Think of the increased production of food, think of it with the fact in mind that well-informed men assert that the morbidity and mortality in the world directly, due to undernourished, are so great in many places that they over-shadow the horrors of the war. Those who are not informed about the evils incident to under-nourishment and long continued dependence on food that lacks essential nutritive elements, and how serious the food shortage in the world is today, may find it difficult to believe that millions of human beings in this so-called civilized age, beings and feelings, affections and souls like our own, are being stunted spiritually and physically and are being hurried prematurely out of life because they cannot get enough to eat or enough of the right kind of food, and yet this evidently is the truth. In the United States the population has increased faster than the number of domestic animals, and this probably is one of the causes for the high price of food. In Europe the war has reduced the number of domestic animals so much that a replenishment from Countries, ours included, in which the animal industry was less severely injured, is urgently needed.

Let us take a look at another disease, about which much unfruitful guessing was done until the truth was learned through animal experimentation; the commonest and most widely disseminated of all diseases, namely, tuberculosis.

Animal experimentation proved that the manifestations of tuberculosis in different portions of the body and in the bodies of different species of animals all have one, essential cause; it proved that the disease is contagious; it showed how and why it is contagious; it led to the discovery of the tubercle bacillus; it proved that the tubercle bacillus in nature is an obligatory parasite; it proved that the bacillus is quickly destroyed by light and may long remain alive and virulent in dark places; it proved that there are three types of tubercle bacilli, the human, the bovine and the avian; it proved that human and avian types have no important significance for cattle; it proved that the avian type is not an important cause of disease among mammals; it proved that the human type is the commoner cause of tuberculosis in human beings; it proved that children often are attacked by the bovine type; it proved that the bovine type is the commonest cause of tuberculosis among domestic mammals; it led to the discovery of tuberculin, without which, used as a diagnostic agent, the control and eradication of tuberculosis among the food-producing animals would be impossible, etc.

If animal experimentation had not proved that tuberculosis among cattle can be eradicated, wholly exterminated, and its recurrence prevented, without regard to its continued persistence among human beings, the cattle tuberculosis eradication work, for which Congress now appropriates one and one-half million dollars annually, would have the character of a hopeless and ridiculous project, unless utterly unreasonable measures were taken to prevent the reinfection of cattle with tubercle bacilli from human sources.

One of the difficulties in combatting tuberculosis, among persons as well as the lower animals, arises from its usually insidious, slowly-progressive nature, through which its subjects often become disseminators of its germs long before their dangerous condition is suspected. Until tuberculin was discovered and its diagnostic value proved, no means were available to detect more than a small proportion of the existing cases of tuberculosis among cattle, and the overlooked and neglected cases, through their unavoidable introduction into healthy herds, insured a further, rapid spread of the disease. Just what this means in terms of economy may be judged from the fact that tuberculosis among the cattle of some of the older and more densely populated countries of Europe is from four to five times as common as it is among the cattle of our country, and that it is from fifteen to twenty times as common among the cattle of our older and more densely populated, than it is among those of our newer and less densely populated states.

Through the use of tuberculin the cattle tuberculosis eradication work is making excellent progress, and this should be gratifying, as the disease is a food destroying evil which should not be left as a burdensome heritage to coming and more populous generations of mankind, who, no doubt, will find the production of sufficient food, even under normal as distinct from war conditions, more difficult than we and past generations have found it to be. The food producing area of the world is fairly constant; actually it does not change much from generation to generation; relatively it grows smaller as the population increases.

Tuberculosis among animals in the United States alone, on the basis of the lower estimate, which I am convinced is entirely too low, destroys at least twenty five million dollars worth of urgently needed food per annum. This estimate was made before the war, at a time when milk cost to the consumer eight and not eighteen cents per quart, and when prime roast beef and porterhouse steak retailed at from eighteen to twenty-five cents per pound.

What I have said about seemingly harmless but seriously dangerous disseminators of disease germs in speaking about tuberculosis applies also to other infectious disease; hence, the discovery of methods that help to distinguish more certainly between safe and dangerous animals reduces difficulties that confront our efforts to control and eradicate other costly animal plagues, and this is a field in which the economic advantages derived from animal experimentation are particularly valuable.

If the various biological tests for diseases, discovered during the last thirty years, had been in use a century or two ago, the importation of several destructive animal plagues, now causing heavy losses in the United States, could have been prevented. For example, our Government is successfully eradicating a disease among horses known as dourine, which entered the United States and gained a foothold because its virus is at times carried by horses which show no symptoms of their dangerous condition. The closest study of such infected horses during the period of time imported animals are subjected to quarantine does not lead to their detection; the complement fixation test for dourine detects them at once; the test was not known until after the unfortunate importation of the disease.

This plague would continue to spread rapidly unless impossible sums of money were spent to check it if the apparently innocent carriers and disseminators of its causative microparasites could not be distinguished through the agency of the test animal experimentation has supplied. Horses may not be as indispensable today as they were before tractors, motor-trucks and other types of automobiles came into use, but the prices asked for them indicate that it will be sometime before we can get along without their services or afford to neglect their diseases.

To offset the example I have given of an instance in which a biological test was discovered too late to exclude an animal plague from our country, though early enough to insure its eradication, I will give one in which a test was available early enough to exclude a more serious plague. The disease in this instance is surra, a pernicious evil, indigenous in the southern portion of Asia, from which it has been spread to several other portions of the world, and which is not at all choice in its victims, as it may attack such widely different species of animals as cattle, horses, sheep, goats, camels, elephants, monkeys, rats, etc. In cattle surra may run a mild course, but once they are attacked they are apt to carry its microparasites in their blood and to remain sources from which the disease spreads for a long time.

A little more than a dozen years ago an attempt was made to introduce a herd of about fifty East Indian cattle into the United States, to be used in Texas, where it was believed the native cattle could be made resistant to southern cattle ticks by crossing them with the Indian cattle, which are alleged to be strongly tick resistant. Repeated examinations of the blood of the Indian cattle were made before their departure from Asia and while they were en route to and after their arrival in the United States, and nothing to arouse suspicion was found; but, while they were in quarantine, rabbit inoculation tests gave absolute proof that their blood was infected with the germs of surra. The economic advantages derived in this instance from animal experimentation, a pattern of things that repeat themselves over and over again, are so great, irrespective of whether we estimate them in money, in food saved or in suffering prevented, that they stagger belief. A somewhat similar story can be told about a threatened introduction into the United States, with a shipment of milk goats, of Malta or Mediterranean fever, a disease of both persons and animals, which may exist in goats in a form that cannot be detected through other means than the use of a test which animal experimentation has given us.

Personal experiences which stamp lasting impressions on our minds often make instructive illustrations. About thirty-five years ago I witnessed the examination, condemnation, slaughter and autopsy of a magnificent, handsome, vigorous, sleek and apparently healthy horse, owned by a wealthy man who maintained a stable of four or five horses for family use. Horse after horse in his stable had contracted acute, easily diagnosed glanders and had been condemned, killed and replaced, only this one fine animal seemed immune, until suspicion was directed at it as the probable source of infection, but not until seven or eight valuable horses had been lost. The owner expressed himself to the veterinarian in charge of his stable to the following effect: "If you believe that the circumstantial evidence which points

to this horse as the source of infection is strong enough, I am willing that it should be killed, though it has never been sick during the time I have owned it, excepting that on one or two occasions it had a slight cold with a meager, clear, watery discharge from its nostrils."

The autopsy revealed a group of small, perfectly typical glanders ulcers on the wall of the larynx and a few small, chronic nodules in the lungs, so located that they could not be detected in the living animal. During two years following the removing of this originally unsuspected source of infection from the stable, after which I have no record, no further cases of glanders occurred. If the mallein or complement fixation test for glanders, later products of animal experimentation, had been available at that time, every horse in the stable would have been tested immediately after the first case of glanders was discovered, and the seemingly healthy spreader of the disease found and prevented from causing further losses. Glanders is transmissible to man, and a hopeless, painful and disgusting disease when it attacks man. Its frequency among horses has enormously declined since it has become possible to pick out seemingly healthy carriers and disseminators of its microparasite through the use of special tests which must be credited to animal experimentation.

Think a moment and realize the significance of the following statement: If the narrow and ridiculous requirement was made that nothing should be favorably credited to animal experimentation but the pain against which it has safeguarded the lower animals through the use of the test it has given us to discover otherwise undiscoverable sources of infection, we would be obliged to admit that it has paid for itself thousands upon thousands of times over again.

Hog cholera is another disease that merits attention, as the losses due to it in some past years have amounted to a hundred million dollars, and in one year are alleged to have reached the two hundred million dollar mark. A serum and a virus to protect hogs against cholera have been developed through animal experimentation by the United States Bureau of Animal Industry, and are now widely used with excellent, economic results. Before they were available many hog breeders and feeders believed that it was a good business policy to assume that their crop of hogs would be destroyed by cholera and be a total loss, on a general average, about once every five or six years. The losses did not occur at regular, determinable intervals, so that a feeling of security could be enjoyed during the four or five years following a loss year. On the contrary, it could not be predicted in any year from the occurrence of previous years whether the hogs would go to the market or whether cholera would get them. This uncertainty did not encourage maximum production; the hog breeding and feeding business was unattractive to conservative men; it was too much like investing money in debatable securities that promise high

rates of interest and too often prove utterly worthless. And, bear in mind, when the high rates were paid on money invested in the hog industry, it was the consumer who settled the bill.

How much animal experimentation has affected the price of pork products may be judged from a statement made by the Secretary of Agriculture and recently published in a News Letter of his Department. This statement asserts that the losses from hog cholera in the United States have been reduced sixty per cent since the year 1913, and that this equals a saving of forty-one million dollars per annum. Let us measure this in food terms. Forty-one million dollars worth of hogs, assuming that the average retail price of pork products is forty cents per pound, amounts to one pound each of nutritious meat or fat on every one of the 365 days in a year for 280,820 human beings. The assumed average price of pork products probably is a little too high; make it lower and the number of human beings benefited increases. The importance of the hog as a source of human food ranks next to that of the dairy cow.

The money saved in the United States in one year, through the economic advantages the hog industry alone has derived from animal experimentation, invested in Victory bonds, would yield an annual income greater than the sum annually appropriated by Congress for the study and control of all the plagues that occur among the domestic animals of our country. This is a fact which should be kept in mind by those persons who claim that our Government is more eager to fly to the rescue of the sick hog than it is to care for the sick child.

The clear-minded men in our Congress who are behind the appropriations made for the protection of our animal industry are not moved by sentimental consideration for hogs or other kinds of livestock; not even by consideration for the breeders and feeders of domestic animals, or for any special industry or class of men. They know what a relaxation of the fight against the existing and possible evils that destroy the food-producing animals would mean to the whole people of the Country, and that the health and welfare of a nation depend on no one thing quite as much as an abundant supply of wholesome food.

Lengthy dissertations, similar to the brief statements I have made about Texas fever, tuberculosis, dourine, surra, Malta fever, glanders and hog cholera, to show the value of the economic advantages derived from animal experimentation, could be made about other animal plagues, such as contagious pleuro-pneumonia, rinderpest, foot and mouth disease, anthrax, blackleg, sheep scab, etc., but our time is too short.

Contagious pleuro-pneumonia of cattle was imported into the United States seventy-seven years ago. Animal experimentation, which definitely proved its contagiousness and further proved that various,

seemingly feasible methods of control were useless, led to the adoption of the methods through which it was speedily eradicated. If we had been tardy about applying the knowledge animal experimentation gave us, the losses from this plague soon would have mounted to hundreds of millions of dollars.

Rinderpest, a terrible destructive disease of ruminants, which has repeatedly spread from its native place in Asia into and over Europe during and after wars, but has fortunately never reached the United States, is being controlled by a method similar to that which is effective against hog cholera. Permit me to give you a few statistics on this plague, as they will help you to comprehend how large the food problems are with which animal experimentation deals, and will show you that the question, whether such experimentation should or should not be hampered by legislation, cannot reasonably be settled by possibly well-intentioned but uniformed and emotionally misguided persons. Introduced into France after the Franco-Prussian war, rinderpest killed 56,533 cattle in two years. Introduced into Great Britain in 1865, it killed 500,000 cattle in 18 months. Introduced into Italy towards the end of the 18th century, it killed 3,000,000 cattle in three years. Introduced into South Africa it killed 980,000 cattle in the Transvaal in 1897 and 1,300,000 in Cape Colony during 1897 and 1898.

Since I have touched on the subject of statistics, let me give you a few about other diseases. Anthrax, which is most fatal to sheep and cattle but also attacks a variety of other animals, including man, is being controlled through the agency of a vaccine supplied by animal experimentation. In France, vaccination reduced the death rate due to this disease among sheep from 10% to 0.94% and among cattle from 5%to 0.34%. Rouget or swine erysipelas is a widespread disease in Europe, the losses from which were reduced through vaccination from 20% to 1.45%. Think of the enormous losses before vaccination; think of the more than 90% reduction in these losses. In one region in Europe, in which tetanus or lockjaw is epidemic and apt to follow wounds of all kinds, 259 cases occurred among untreated horses, and not one among 7,000 which received injections of tetanus antitoxine. I advise the anti-vivisectionist who visits this region and accidentally steps on a rusty nail not to fight too hard against the preventive treatment for tetanus or lockjaw, because its discovery cost the lives of a number of experiment animals.

Blackleg, like anthrax, is caused by a spore-forming, vegetable microparasite. The spores of both diseases live and retain their virulence long periods of time when they enter the soil, and on infected soil it is economically impossible to raise sheep and cattle unless they are immunized. The United States Department of Agriculture annually distributes from two to four million doses of blackleg vaccine, because the men who raise cattle in portions of our country where the

infection exists have learned through experience that the losses from blackleg among their young stock, unless it is immunized, are unbearable. Practical men do not look upon the use of antitoxic sera, vaccines, bacterins and other biological products as an academic question or a subject for sentimental speculation. With them a thing must pay; else it is discarded. Quack remedies may receive a trial but are soon discredited, and when thousands of level-headed business men demand and use the same agent year after year, it must have a real virtue.

About foot-and-mouth disease we know relatively little, although we do know how extremely contagious and destructive it is, and that it may attack a number of different species of animals. The recent outbreaks in the United States should be fresh in the minds of those who are interested in the source of our daily food. To keep this plague out of the country, to detect it at once when it gains entrance, to suppress it without extravagant and unnecessary expense, is possible only through tests in which living animals are used. Through animal experimentation it has been proved that this plague, the losses from which would soon mount to unbelievable figures if it were permitted to ravage unchecked, may be imported in ways that cannot be opposed by animal quarantine.

Sheep scab, which at one time threatened to destroy the wool-growing industry in some parts of the world peculiarly adapted for sheep culture, has become a relatively unimportant evil through animal experimentation.

The mysteries of infectious abortion disease of cattle, an evil which might have been kept out of our country if the agglutination or complement fixation test had been available early enough, are gradually but surely being revealed through animal experimentation, and this widespread, chronic plague, prevalent especially among dairy cattle, and which is estimated to cost the Nation upwards of forty million dollars per annum, it is hoped will soon be amendable to control. It is an uncommonly prolific disease in those unsuspected and dangerous carriers and disseminators of infection which can be detected only through the use of the special biological tests.

As I indicated in the introductory paragraph of my address, the economic advantages derived from animal experimentation are so great, numerous and varied that only the high points can be touched here and there in the time at my disposal. Volumes could be written on the subject without exhausting it or doing it justice. For instance, I have not referred to the excellent work that has reduced the losses caused by the larger parasites of domestic animals, parasites about which we have gained much knowledge through animal experimentation and about which more, urgently needed knowledge can be gained by further experimentation, as is well illustrated by the light recently thrown on the life history of the ascaris, a large parasitic round worm

with which most persons are acquainted. This worm, which inhabits the intestine in its adult stage, is now known to have a larval stage during which it lives in the lung, where it can cause inflammatory processes and may be found to be a direct and secondary cause of trouble.

Another line of experimentation I have not referred to concerns animal foodstuffs, a field in which an enormous amount of work has been done, the value of which lies not only in securing the best balanced and most economical rations for animals, but also in making foods available which, if their value had been determined by accidental occurrences, would be a total waste, as is shown by the history of cotton-seed products as food for animals. The early use of cotton-seed products caused many deaths among cattle and was particularly fatal to swine. Today cotton-seed products must be ranked among the abundant and very nutritious feeds of domestic animals. Thanks to animal experimentation. You see it is a large subject.

Those who are in doubt about the value of the economic benefits derived from animal experimentation should first learn what they are and then try to determine what this world would be like today if unreasoning sentimentality had led us to place animals on a plane too high to justify their use for experimental purposes. Ask what it would mean to have a long list of parasitic and micro parasitic diseases ravaging unchecked, each causing yearly losses that could be expressed in no less than seven, eight and nine figures, and the total of which in our country would require ten figures. Remember the part animal experimentation played in the construction of the Panama Canal; in the enormously increased prosperity of a territorial area in the United States great enough in size and fertility to maintain a population in excess of one hundred million human beings; in the exclusion of foreign food and apparel destroying diseases and in the control and eradication of infectious diseases native to our soil and those that unfortunately entered from without.

And, while thinking of these things, bear in mind that, though great things have been accomplished, much remains to be done. The experimental method of studying living organisms and the things that may affect them beneficially and adversely is comparatively new. Practically everything we know about physiology, pathology, biochemistry and the actions and uses of drugs is less than a few hundred years old, most of it less than a hundred years, and practically everything we know about infectious diseases, excepting that they are communicable and harrowingly destructive, is no older than many men who are now alive. I myself remember when the contagiousness of tuberculosis was a common subject of controversy; when it was profoundly believed that the disease was hereditary and when Koch's discovery of the tubercle bacillus was regarded as an amusing claim rather than a great, momentous addition to our knowledge.

We must go unhampered in this work; to check its progress, to put obstacles in its way, to delay the acquisition of the further knowledge it will give us, means ingratitude to the splendid workers who have provided the foundation on which we can build; inhumanity to those who look forward hopefully to relief from numerous preventable causes of pain, sorrow and loss, and good reasons to expect the contempt of unborn and more enlightened generations. Animal experimentation truly is a lamp that has illuminated many dark places, and the light from which is urgently needed to expel remaining darkness. Do not permit it to be extinguished or dimmed.

Only a few words more, and they concern the opinion expressed now and then that future generations will laugh at what we call our knowledge as we have laughed at some of the so-called knowledge of past generations. We should not quarrel with this opinion when it is limited to hypotheses and theories, which are rarely permanent and which every educated person accepts as temporary substitutes for unobtained knowledge. But its application to demonstrated facts is wholly another matter, which fails to take into consideration that the longest and most important stride forward in the world's intellectual development of which we have any record, so far as material things are concerned, was taken when the experimental method to gain knowledge was adopted. And now I am talking of the experimental method generally, and not specifically of that part of it which necessitates the use of living animals.

The experimental method has made it possible to discover and prove facts, to distinguish between facts and theories, and to discard untenable beliefs and hypotheses. Facts are permanent additions to the sum total of human knowledge and constitute real knowledge. The present generation does not laugh at the facts revealed and proved by past generations, and coming generations will not laugh at the facts our generation reveals and proves. The experimental method, which insists on demonstration before acceptance, has the healthy responsibility for our present low valuation, not of the real knowledge of any age or time, but of the speculative philosophies and sophistries which burdened the minds even of wise men before it came into use.

THE ACHIEVEMENTS IN DENTAL MEDICINE AND ORAL HYGIENE.

By

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To one in constant contact with the varied phases of human suffering occasioned by disease; to the laboratory worker, whose life is consecrated to the task of seeking out the hidden causes of disease; to

the sanitary officer whose duty calls him to protect the health of the community; to the armies of trained investigators whose mission is to protect the world from the ravages of epidemic and pandemic disease, the question of being obliged to defend the methods necessarily employed seems at first glance, to be an insult to the public intelligence.

During the present period of world-wide stress we find ourselves witness to an example of experimental legislation that seriously impairs our personal liberty in this theoretically free country. By similar methods of pernicious propaganda the opponents of vivisection, without justification other than motives of misguided sentiment, for the sake of a comparative handful of animals, contemplate the destruction of the entire fabric of scientific medicine, and by retrograde metamorphosis would relegate us to the middle ages to prescribe imaginary remedies for diseases as they exist in the nomenclature of speculation. It is of utmost importance that the public be placed on guard against this insidious campaign of distortion and misrepresentation, which, if successful, would stay the march of medical progress, would destroy the possibility of an exact medical science and would result in greater toll of human life than imagination can conceive.

In the limited time at my disposal I shall endeavor to show the necessity for animal experimentation in the practice of dentistry, and by the introduction of some of its problems point out the future possibilities of an art so closely allied to that of medicine that the border line between the two professions becomes obliterated.

The evolution of dentistry as a science parallels that of medicine to such an extent that discoveries in either branch have left a common impress. The Egyptians practiced as specialists at an early date and mummies recovered from their resting places bear mute testimony to the dexterity with which the teeth were filled and crowned with gold. At the school of Salernum instruction was given in the surgery of the mouth and operations on the teeth. Under the influence of this school dentistry was taught as a part of the surgeon's routine practice. France in 1700 was the first country to recognize dentistry as a specialty. The first complete treatise on dentistry was written by Fauchard in 1728. Previous to this date gleaners of dental literature must seek the medical and surgical writings.

Three centuries ago, Francis Bacon made an exceedingly accurate comment on the practice of medicine. "Medicine is a science which hath been, it is said, more professed than labored; and yet more labored than advanced; the labor being in my judgment rather in circle than in progression; for I find much iteration, but small addition." The accuracy of Bacon's diagnosis remained unchallenged for nearly 200 years, when Jenner in 1796 presented his gift of vaccination to humanity, and fifty years later the priceless boon of anesthesia was introduced.

Thus did medicine escape from that vicious circle so aptly epitomized by Bacon.

In the discovery of anesthesia the dental profession claims equal share of honor. Long and Jackson being physicians; both Wells and Morton were dentists. At that instant animal experimentation became more humane, more useful and more accurate.

The use of the microscope as a scientific instrument had its origin in 1683 when Van Leeuwenhoek, the Dutch lensmaker, made observations on tartar scraped from the teeth and described bacteria for the first time. It is recorded that in his enthusiasm for scientific research he extracted one of his own teeth and thereupon discovered the tubular nature of dentine.

To the genius of Louis Pasteur is accredited the introduction into the world of Bacteriology, a young giant destined to revolutionize medical thought and research, to banish empiricism and to place medicine on a rational and scientific basis. In the last forty years it has accomplished more for the benefit of humanity than has any other branch of science in many centuries. Beginning with Pasteur's investigations into the cause of fermentation, and the overthrow of the theory of spontaneous generation, it gave to Lister in 1875 his inspiration which resulted in the so-called antiseptic surgery ushering in a new era. By the adoption of sound principles of treatment based on the prevention of infection much of the odium attached to hospitals at that time was removed. To this changed viewpoint may be attributed the success and popularity of the present-day hospital.

For a considerable period after Pasteur's first discoveries bacteriologic investigations marked time while methods of cultivation and study were being improved. So that the young science was not firmly fixed upon its pedestal until Koch formulated his famous postulates. The observance of these laws in the course of bacterial study placed a necessary curb on overenthusiastic investigators and enabled the conservative ones to verify their work in many instances with the precision of the mathematician.

"1. The specific organism must always be associated with the disease. 2. When isolated and (3) introduced into a healthy susceptible animal it must produce the same disease. 4. From that animal it must be again obtained in pure culture."

These simple rules based on the employment of animals constitute the rock upon which the science of bacteriology was founded. The rock of science which the antivivisectionists would annihilate that we might build our house once more upon the shifting sands of ignorance.

I shall not burden you at this time with a picture of that triumphant march of discovery that began under the leadership of Pasteur and continues to this day as a true crusade in the cause of humanity.

Riggs in 1875, actuated by the rapidly crystallizing germ theory of disease, recognized the bacterial factor in the production of that symptom-complex known as pyorrhea alveolaris, the curse of the human race for ages. Rigg's disease has experienced more vicissitudes of classification than any other disease in the nomenclature. From the time of its first recorded observation in 1746, it has been the storm center of controversy between those who believe it to be a constitutional affection and others having firmly fixed opinions as to its purely local character. It is pleasant to note in passing that research work now being done—by means of animal experimentation—bids fair to settle the controversy in the near future.

About thirty years ago Miller, distinguished for his work in dental pathology, directed attention to oral sepsis as a possible cause of constitutional disease, but failed to impress either profession with the importance of his observations.

In 1910 William Hunter, of England, pointed out the possibility of systemic infection through lesions of the mouth, and at a later date his observations were verified by the laboratory findings of Rosenow, who, in the course of investigation of the blood in certain anemias, rheumatism and heart disease, was able to isolate certain organisms from the blood and frequently found them to be identical with the bacteria cultured from patients suffering from pyorrhea and dental abscesses. While bacteria are capable of entering any unprotected or injured part of the body, it was found by Rosenow that the most common portals of entry were through the mouth, the nose and the tonsils. It was verified clinically by the prompt amelioration of symptoms when the dental abscesses and the pyorrhea received proper treatment.

The term focus of infection means that disease-producing bacteria have established a permanent residence in some part of the body, and from that point their toxines (or poisons) are continually absorbed to the detriment of the individual's health. In some instances and under favorable conditions, the organisms themselves may enter the blood stream and be transported to some other part of the body where serious disturbances may arise after their arrival in the new territory. Thus it is that certain forms of anemia, rheumatism, diseases of the heart and kidney may be traced back to some original focus of infection.

When we become possessed of a new automobile it is difficult to repress the tendency to violate the speed laws. When a new idea in the form of a medicine or surgical operation is brought to light, it is often seized by its partisans as a last hope of salvation. The effect of this overstimulation is seen by an immediate epidemic of prescription writing or of needless operations. I distinctly remember that surgical era when the combination between a small boy and a hatful of green apples meant a probable operation for appendicitis. Fortunately with the progress of scientific medicine these hasty conclusions are becoming more and more rare.

It is also true that teeth have been extracted when the focus was in the tonsil or even in the gall bladder. Hence it is of greatest importance that the oral surgeon be especially qualified for a task that demands the greatest diagnostic skill and judgment. The time is now at hand for an interchange of viewpoint between the medical and dental professions. To many minds the ideal solution of the problem would be to raise the standard to such an extent that a knowledge of medicine would be a prerequisite to the study of dentistry, and the practice of oral surgery would take its proper place as a specialty of medicine. Roswell Park entertained these views twenty-five years ago, and their correctness has been amply verified.

The present status of the graduate in dentistry in this country is due in great measure to chance. Chapin Harris, a physician, recognizing the need for more thorough training in the dental art, visited several medical schools in the endeavor to make dentistry a specialty of medicine. These schools lacking the breadth of Salernum declined the overtures, and Dr. Harris in 1839, organized the first dental college in the world—the Baltimore College of Dental Surgery.

The achievements of dentistry in the past are due in great measure to a high development of mechanical skill, recognized throughout the civilized world; those of the future will depend on the result of intensive research, now in progress, along the lines of preventive medicine, diet, metabolism and oral surgery. It is not mere speculation to say that the present high cost of living accompanied by the inevitable food substitution will furnish new problems for solution by experimental means.

Our beloved autocrat, Dr. Oliver Wendell Holmes, in addressing a class of dental graduates in 1872, had this to say of oral hygiene: "You can tell the state of a village by going to the mill. If it has enough to grind and grinds it well and cheaply, you will find good farms and well-fed people; so if you see a good square jaw, filled with good sound teeth, and moved by a set of muscles that mean business, and do it, you will find in all probability that they nourish a sound frame in man or woman."

The history of medicine tells us that all great wars have taught their lessons. One of them of interest from a medico-dental standpoint is the report of the provost marshal's office. We find that over 34 per cent of the registrants in the draft of about 10,000,000 men were rejected on account of disability. We also note that many of the diseases for which the registrants were rejected are diseases directly traceable to focal infections. In view of the fact that 90 per cent of the people of this country never consult a dentist we can readily account for so many rheumatic and heart diseases. When we add to this information the commonly repeated statement that between 80 and 90 per cent of our school children are afflicted with decayed teeth, we

are impressed by the magnitude of the problem. Decayed teeth obviously reduce the child's ability to study, lower the resistance to disease, and pave the way for future illness. This is a problem in which the oral hygienists, the school authorities, the social workers and physicians may unite to effect a solution. From the foregoing it will be seen that there is still need for laboratory animal experiments.

The initial lecturer in this series, Dr. Simon Flexner, presented a magnificently pictured outline of the world-wide activities of the great Rockefeller Foundation, tracing the development of scientific thought and of the means that have been employed toward the elimination of all disease. With unlimited resources at its disposal it has been of untold benefit in the reduction of mortality from disease. At the present time it has adopted the world as its patient, and regarding epidemics as focal infections has sent investigators to the most remote regions of the globe in order that these scourges may be swept from the face of the earth. We trust that this institution, one of the most powerfully organized and intelligent forces in the cause of humanity, may, as years roll on, attain the goal of its ambition.

It has been clearly shown that man has a right to use, for any purpose, the animals that have been placed in his domain. It has been shown that animals must of necessity be utilized for the purpose of determining the specific nature of micro-organisms, for the standardization of drugs, for the manufacture and standardization of antitoxines and vaccines, and also for the perfection of surgical operations. Any curtailment of this right would result in irreparable damage to scientific medicine. Each of the lecturers voiced with me their contempt of wanton cruelty and needless sacrifice of animal life. It has been shown conclusively that no necessity for additional legislation for the protection of animals exists. This is clearly shown by the failure to respond to the challenge issued by the Health Officer of the District of Columbia in 1901, to produce a single authentic case of cruelty to animals within the walls of any medical school in this city.

Let us not forget that some of our most far-reaching discoveries were made possible by experiments on heroes who voluntarily sacrificed their lives upon the altar of science.

When we think of the great economic benefits derived from animal experimentation, of the lives that have been saved, of the maimed and crippled that have been restored to usefulness, of the pain and anguish that has been assuaged, can we imagine that the faithful dog, could he have voice, would give his consent to the assassination of science?

CONCLUDING REMARKS TO THE COURSE OF LECTURES ON VIVISECTION

By

GEORGE M. KOBER M. D., LL. D., LITT. D.,

Dean of the Georgetown University School of Medicine.

These two excellent lectures of singular importance conclude our course, at least for the present. We have already bespoken our appreciation to the two speakers of the afternoon, and I deem it a duty now to voice our indebtedness to the Rev. Francis A. Tondorf, S. J., the responsible party for the inauguration of this splendid course of dissertations on a subject of such vital importance to the progress of medicine and hence to the entire community.

You are aware, no doubt, that there is a bill now pending before the Senate which is to prohibit all experimentation on dogs and which would eventually lead to the prohibition of experimentation on all animals. Hearings were held before the Senate Judiciary Committee last November, and these were attended by leading scientists from all over the country. Father Tondorf had been invited to address this body, and his appeal for the rejection of the bill was based entirely on moral principles. As indicated above, the Committee's judgment is still pending. It seems quite certain that they are not in favor of the measure, yet it is not impossible that they may report favorably on the bill at some future date, yielding to public sentiment, should such sponsor the cause. Accordingly the Washington Humane Society has been urging an active propaganda along these lines.

In the earlier part of February last a mass meeting was advertised to be held at the Shoreham Hotel under the auspices of the above-named society. The notice met the attention of one of the premedical students of the Georgetown University who promptly advised Father Tondorf of the proposed meeting, asking him, if possible, to be present that both sides of the question might be presented. Father Tondorf, in turn, advised me of the same, and after consultation it was decided that both of us should attend the meeting and that we should see to it that the movement should not gain headway without the public being made conversant with our side of the question.

The meeting was addressed by a Mr. Russell, one-time editor of the New York Times, a journalist of considerable repute. In the course of his remarks he most insistently pressed all present to activity toward the passage of the bill, adding that once a legislative measure had been enacted regarding the dog, the way to the other animals would be easy. He hinted that a new powerful weapon was within

reach, to wit, women suffrage. His impeachment of the medical profession was scathing. Vivisectionists were branded as materialists. His attitude in its entirety was extremely aggressive. Father Tondorf asked Mr. Russell whether he had ever read the life of Louis Pasteur, and when he replied that he had not, he advised him to do so, before ever again repeating such statements, as he would find that Pasteur was not only a most fruitful scientific experimenter, but also much beloved and revered by all who knew him for the beautiful spiritual life that he had led.

Mr. Russell had also sketched in sarcastic language the history and development of medicine, referring especially to the blood letting and calomel era in the treatment of disease. I informed the audience that there were periods when medical men were obliged to experiment upon man instead of the lower animals, which involved lamentable consequences. According to Professor Finkelnburg of Bonn the average span of human life in the sixteenth century was between 18 and 20 years; at the close of the seventeenth century it was between 25 and 30 years, at the close of the eighteenth century it did not greatly exceed 38 years, while at the close of the nineteenth century it was between 45 and 50 years. Death is inevitable, but human life and happiness has been prolonged, and this has been accomplished largely by animal experimentation in which our faithful canine friends played a very important part. The press comments of the following day relative to this meeting left little doubt that Father Tondorf's able rebuttal amply met Mr. Russell's charges.

Yet we, of the opposition, left this meeting convinced that a new plan of campaign was imperative. Hitherto vivisectionists were generally contented in waiting on the defensive. Accordingly Father Tondorf called a special meeting of the faculty of the Georgetown University Medical School on February 23. Forty members of the faculty were present. The matter was freely discussed, and it was generally agreed that, as similia similibus curantur, we, too, should launch an aggressive campaign.

A committee, appointed by the president, consisting of Col. William H. Arthur, U. S. A., Director of the Georgetown University Hospital; Rev. Francis A. Tondorf, S. J., head of the Department of Physiology, Georgetown University Medical School, and myself, settled upon this course of lectures on animal experimentation, viewed in its various aspects of Medicine, Philanthropy, Ethics and Economics, by men of the highest authority in the medical and other professions.

I also called this matter to the attention of the members in session upon the Congress on Medical Education held in Chicago March 1 to 3, with the result of the unanimous adoption of the following resolution:

"The annual Congress on Medical Education, composed of the Council on Medical Education of the American Medical Association,

the Association of American Medical Colleges and the Federation of State Medical Boards of the United States, has learned with regret that serious efforts are being made to enact Senate bill 1258, 'A bill to prohibit experiments upon living dogs in the District of Columbia and in any of the Territorial or insular possessions of the United States.'

"The highest aim of scientific medicine is the eradication of preventable diseases. The average span of life in the United States has been lengthened fully eight years during the past twenty-five years, largely the result of animal experimentation in the study of the causes, prevention and treatment of communicable diseases.

"A careful examination of the law in force in the District of Columbia shows that the provisions of the current law are ample and sufficient to prevent cruelty to animals, and since the enactment of the bill would be the death knell to the progress of scientific medicine, this Congress respectfully but earnestly protests against its enactment as unnecessary legislation and detrimental to the best interests of the human family, and to animal husbandry."

The course of lectures just completed has sustained the position of our Faculty and that of the Congress on Medical Education, and it is hoped that even our opponents have profited by this campaign of enlightenment. We now rest this matter with the fair-minded public. Should our well-meaning friends, misguided though they be, fancy that any undue advantage has been taken of them, I am quite sure the University authorities will gladly afford them an opportunity of refuting from this same platform any statement made by any of the lecturers.

MORAL ASPECTS OF VIVISECTION.

A Digest of the Statement of

REV. FRANCIS A. TONDORF, S. J., PH. D.

Head of the Department of Physiology, Georgetown University School of Medicine

Before the

Subcommittee of the Committee on the Judiciary of the United States Senate, November 4, 1919, S. 1258

on

A Bill to Prohibit Experiments Upon Living Dogs in the District of Columbia or the Territorial or Insular Possessions of the United States.

MR. CHAIRMAN:

The topic now under discussion presents two phases, to wit, the sentimental and the moral. The former, I take it, deserves little, if any, consideration, where human health and happiness are at stake. The latter rests wholly on philosophical principles. These I purpose, with your kindly indulgence, briefly to review.

God has unquestionably placed the creatures of His hand under man's dominion that they may be of service to him in the prosecution of his necessary end. Accordingly he has an unequivocal right to the use of these creatures for any lawful purpose he sees fit. I insist on lawful purpose, the norm being that in this use man violates no obligation toward God, himself or his fellowmen. Pleadingly our friends, the antivivisectionists, bid us add a fourth condition, namely, that the animal's right be held sacred. I answer, as anyone familiar with the first principles of ethics must answer, an animal has no rights. A right is a moral power, and a moral power is resident only in a rational being. To invoke barnyard rights is to codify barnyard morals.

Very logically it is now inferred that no irrational being can suffer an injustice, for there can be no injustice where the injustice is not recognized, and where there is on the part of the subject no expression of unwillingness. Nor have we here the semblance of a sanction for any wanton use of animals in laboratory experimentation. The second condition above indicated strictly inhibits this. To preclude any possible misconception of the term wanton, I would define it as any such use as would occasion unnecessary pain.

It may be urged that granting all this, vivisection still lacks justification in that no useful results have ever accrued therefrom. You have just heard the curious recital of data by the opposition in their

attempt to prove that our many hours of research have been hours idly spent, and you have heard my colleagues to the contrary. Your judgment is easily anticipated. But were we to admit, for the sake of argumentation, that all our efforts to date have been fruitless, with the possibility of future experimentation, important findings might still be reasonably hoped for, a sufficient warrant surely for the continuance of researches.

But no, the atrocities must not be permitted to continue because they are "Sanctioned Infamy," "Scientific Torture." So the first speaker on the other side. A catalogue of our cruelties has been handed you. They all have their foundation in the pain we inflict. To fix a footrule of this, so-styled, cruelty therefore we first need evidently understand what pain might be. Physiologists know comparatively very little about pain. They inform us that of all the senses, this sense is the most widely distributed, naturally so, as it is the body's safeguard. That it is a poorly localized sense. The nerve fibres mediating pain they hand us accurately charted. But no one seems to touch a point which is of vital import right here, and that is whether the pain sense is as specialized in the brute as it is in man. The indications are all in the negative. Such the brute's position in the scale of anatomy. Such the post-operative behaviour which every experimenter cannot but have noticed, a behaviour indicating a minimum suffering. Such, finally, the ante and post operative consequences to a lack of anticipation of pain, a factor which so tellingly exaggerates this sense in the human subject. In the light of the above it is not hard to see that the tales of all our cruelties are but the wild fancies of prejudiced imaginations.

With the right to inflict pain on the animal established, and I might state that this we rarely do as most operations are done under an anesthetic, I ask to what extent this infliction is permissible. As far as is necessary. Nor am I of the mind that this is only a right but more a solemn obligation we men of the medical profession owe mankind. I rest my argument here and challenge the opposition to reply.

STATEMENT OF

GEORGE MARTIN KOBER, M. D., LL. D., LITT. D.,

Dean and Professor of Hygiene and Preventive Medicine, Georgetown University Medical School.

Before the
Sub Committee of the Committee on the Judiciary of the United States Senate on November 4, 1919.

Mr. Chairman: As dean and representative of the medical school of Georgetown University, I am directed to enter a respectful but emphatic protest against the passage of Senate bill No. 1258, to prohibit

experiments upon living dogs in the District of Columbia, etc., for the reason that a careful examination of the law now in force made by Dr. William C. Woodward, our professor of medical jurisprudence, formerly the efficient health officer of this city and now health commissioner of Boston, shows that the provisions of the current law are ample and sufficient to accomplish the laudable object of the advocates of the bill, which, I take it, is the prevention of cruelty to animals, including our faithful friend and companion, the dog. If, on the other hand, the advocates insist in prohibiting experiments upon living dogs, and this sentiment is enacted into a law, it will be the death knell to scientific medicine and the amelioration of sickness and distress for reasons already explained to you by other speakers.

As we understand the case, under the current law, enacted in 1871, or 49 years ago, amended in 1873, 1885, and 1892, the members of the Washington Humane Society have extreme power relative to the search of private premises in which there is reason to believe animals are being needlessly tortured; that it is not only the privilege but also the duty of every member of that society, as well as of every peace officer, to enforce the law against such offenses; and that members of the Washington Humane Society are offered a special inducement to perform their duty by reason of the fact that all fines and forteitures become the property of their society; and, finally, that any person undertaking to perform experiments involving suffering on the part of any of the lower animals is protected from punishment only when such experiments are performed under the authority of some regularly incorporated medical college, university, or scientific society, and even then only as long as they are properly conducted.

If this interpretation of the law by Dr. Woodward is sustained by your honorable committee or its referees, the current law is broad enough to accomplish the purpose. If, on the other hand, it is claimed that the present law is defective and inoperative, the burden of proof for additional legislation clearly rests with the advocates of this measure and should emanate from unbiased sources. Technically, the proper way for obtaining such an opinion would appear to be by the presentation of a specific case to the prosecuting attorney and his refusal to institue proceedings because of the inefficiency of the present law or by the presentation of a specific case to the court and its dismissal by the court for the same reason.

Is there a real need for additional legislation? The answer to this question may be found in the fact that the Washington Humane Society, clothed with extraordinary powers, has failed to demonstrate during the last 49 years a single case of abuse. If this be true, it is fair to assume that the evils complained of do not exist, or that the members of that society have been derelict in their duty. The writer is unwilling to accept the latter explanation, since the members of the society have shown marked zeal and devotion not only by their per-

sistent efforts year after year in pressing the so-called "antivivisection bill" but also by their indefatigable efforts to collect and present evidence in favor of the bill. For this purpose the files of newspapers, periodicals, medical journals, and the transaction of the British Royal Commission on vivisection have been searched, but a most careful scrutiny of the evidence fails to reveal a single instance of cruelty to animals committed in the District of Columbia.

Mr. Chairman, the highest aim of scientific medicine is the eradication of preventable diseases. In this we have made most commendable progress, for medical history reveals the fact that during the Civil War out of every 1,000 soldiers enrolled 65 died annually, and that during the Spanish-American War the losses were still 30 out of every 1,000, while during the recent World War the mortality was only 14.8 per 1,000.

These brilliant results were largely made possible by animal experimentation in which our faithful canine friends played a very important part.

But, Mr. Chairman, let me remind you that man himself, the highest of God's creatures, has shared the dangers on the battle field against the foes of mankind, and our great and glorious country may well be proud of the heroes who gave up their lives or offered themselves for experimentation for the benefit of humanity. The yellow fever commission, with Maj. Walter Reed as chairman, in 1900 demonstrated the transmission of yellow fever by the mosquito, which more than anything else made the construction of the Panama Canal possible, and without which the ultimate eradication of this scourge could not be accomplished. I shall never forget the glowing tribute which Dr. Reed paid his colleagues for their share in the work which made him famous, especially to that brave young soldier, Kissinger, from Ohio, who on December 5, 1900, was the first volunteer to be bitten by infected mosquitoes, with the only provision that he should receive no pecuniary reward, since as he expressed it, he was actuated "solely in the interest of humanity and the cause of science." Such exhibition of moral courage, in the opinion of Dr. Reed, has never been surpassed in the annals of the Army of the United States, and I will add, could never have been inspired except by a man of Dr. Reed's greatness.

The story of Sternberg, Reed, Agramonte, Carroll, and Lazear in the battle against yellow fever has never been acclaimed with flags or decorations but a grateful country has recognized the services of those noble workers by granting a pension or annuity to the surviving members or families, except in the case of Dr. Agramonte, who is still alive, a faithful worker and teacher in preventive medicine in the city of Havana.

Other medical men in the United States who with genuine American manhood have fallen victims of scientific research are Dr. Howard T. Ricketts, who investigated typhus fever in Mexico, Dr. Thomas B. McClintic, of the United States Public Health Service, who died from Rocky Mountain fever contracted while investigating the cause of this disease; and Dr. William W. Miller, of the same service, who died of typhoid while investigating that disease in this city.

The recent World War has also developed a number of striking demonstrations of genuine devotion to science and humanity. We read in the Journal of American Medical Association October 11, 1919, that two groups of our brave men modestly made a great sacrifice for their country and for mankind in connection with scientific investigations during the Great War. One group offered themselves as subjects for the study of the puzzles that threatened to work great havoc among the forces at the front.

As trench fever apparently is not transmissible to animals, the recourse to human subjects became imperative. The volunteers lent themselves to the demonstration that the blood of trench-fever patients is infective in order to ascertain what element of the blood contains the virus and to discover the relation of the louse to the dissemination of the disease. The story of some of these endeavors and sacrifices has been recorded in the report of the medical research committee of the American Red Cross (New York Oxford University Press, 1918). "Words fail," says the report, "in attempting to express admiration of the morale and courage of the volunteers. They have more than done their part by endeavoring to aid in the accuracy of the experiments." Today trench fever can be controlled.

Another volunteer sacrifice has been recorded in the efforts of the Army Medical Staff to find a method of preventive innoculation against measles. No physician need be reminded of the dangers to which this disease subjected millions of our men in the two years just passed. Here again, in time of need, to quote Maj. Sellards, who conducted the tests, "the individual soldier was found ready and willing to offer his services and accept such risk as was inherent in these inoculations." This demonstration proved that measles could not be inoculated with blood from measles patients.

To these loyal men the following tribute has gone. "The Surgeon General has been informed of the fact that you volunteered for the measles investigation. He desires to express to you his appreciation of the patriotism and devotion to duty that you have shown, and to assure you that your contribution to the cause is appreciated by him just as much as was the bravery of the men who went into the fight in France."

In the Journal of the American Medical Association for October 25, Surg. Gen. Braisted of the United States Navy tells us that his annual report for 1919 (now in press) contains the names of 138 enlisted men of the Navy who volunteered to undergo certain experiments to determine the mode of transmission of influenza. The experiments were performed when the epidemic was at its height, and

the men who volunteered for them not only knew of its awful fatality but also had been witnesses of the demoralization and terror that beset communities and individuals as this public calamity garnered its thousands and tens of thousands of victims.

As well expressed by Dr. Braisted, "These men are heroes in the fullest and most beautiful meaning of the word, and we should know about them and publish to the world the story of their deeds.

"It is impossible to honor too highly the nobility of these men who voluntarily, calmly, cheerfully jeopardized their lives in the conduct of an experiment undertaken to elucidate the obscurities of diagnosis and treatment, who do this, with none of the inspiring features of battle and no prospect of being welcomed home as heroes, if they survive, yet have had fully explained to them the risk they incur."

Realizing as we all do that sickness is the most potent cause of poverty and distress, it is clearly our duty to diminish the ravages of disease. May I not, as a teacher of hygiene and preventive medicine, venture to express the hope that the bill before you will not be enacted, so that the warfare against preventable diseases which has been so successfully waged by man and his pet companion may go on until the eradication of the invisible foes of mankind is finally accomplished.

Mr. Chairman, I have always been a friend of the dog, and am familiar with his faithfulness and keen, almost human intelligence; indeed, one of my great personal losses in life was the death from hydrophobia of a family pet, who was the victim of the bite of a rabid dog, which might have been prevented had not our well-meaning but misguided friends of the Washington Humane Society objected to the muzzling of dogs.

I thoroughly appreciate many of the virtues of the dog set forth in the Bill S. 1258, and recall with genuine admiration the almost human sympathy which my own pet companion evinced for the sick and wounded soldiers under my care in the early seventies, when stationed at some of the frontier military posts in the far West. His display of affection seemed almost supernatural, and I would never have dared to mention some of the evidences of canine sagacity except for a letter published in the Philadelphia Medical Times, dated May 1, 1875, on page 496, written by Dr. Walter F. Atlee, one of America's great surgeons, which is as follows:

"DEAR SIR: In a letter recently received from Lancaster, where my father resides, it is said, "A queer thing occurred just now. Father was in the office and heard a dog yelping outside the door; he paid no attention until a second and louder yelp was heard, when he opened it and found a little brown dog standing on the step upon three legs. He brought him in, and in examining the fourth leg found a pin sticking in it. He drew out the pin, and the dog ran away again."

"The office of my father, Dr. Atlee, is not directly on the street, but stands back, having in front of it some 6 feet, a stone wall, with a

gate. I will add that it has not been possible to discover anything more about this dog.

"This story reminds me of something similar that occurred to me while studying medicine in the same office nearly 30 years ago. A man named Cosgrove, the keeper of a low tavern near the railroad station, had his arm broken and came many times to the office to have the dressings arranged. He was always accompanied by a large, most ferocious looking bulldog, that watched me most attentively, and most unpleasantly to me, while bandaging his master's arm. A few weeks after Cosgrove's case was discharged I heard a noise at the office door, as if some animal was pawing it, and on opening it saw there this huge bulldog, accompanied by another dog that held up one of its front legs, evidently broken. They entered the office. I cut several pieces of wood and fastened them firmly to the leg with adhesive plaster after straightening the limb. They left immediately. The dog that came with Cosgrove's dog I never saw before or since."

These remarkable observations on canine sagacity by a distinguished and reliable surgeon lead me to the conclusion that if the faithful, courageous, and cheery friend of man could be heard in this controversy his answer would be in the spirit of "self-sacrifice" for the benefit of the human race.

In conclusion I submit a further statement in support of our plea prepared by Dr. Murray Galt Motter, formerly professor of physiology, and desire to emphasize the moral aspect of the question as presented by Rev. Father Francis A. Tondorf, at present professor of physiology in our medical school. The Christian virtues and human sympathies of both of these men are well recognized in this community.

Since some of our friends have questioned whether a man in black cloth is competent to speak on this question, I may say that is is not unusual for a priest to be engaged in the scientific study of medicine, for Garrison, in his History of Medicine, tells us that the earliest of the microscopists was the learned Jesuit priest, A. Kircher (1602-80), who was at once a mathematician, physicist, optician, orientalist, musician, and virtuoso, as well as a medical man, and who was probably the first to employ the microscope in investigating the cause of disease. In his Scrutinium Pestis (Rome, 1658) he not only details seven experiments upon the nature of putrefaction, showing how maggots and other living creatures are developed in decaying matter, but found that the blood of plague patients was filled with a countless brood of worms not perceptible to the naked eye, but to be seen in all putrefying matter through the microscope. While Kircher's "worms" could not have been identical with the Bacillus pestis, as they are invisible with a 32-power microscope, yet it is quite within the range of possibility for him to have seen the larger microorganisms, and he was undoubtedly the first to state in explicit terms the doctrine of a "contagium animatum" as the cause of infectious disease.

A PLEA FOR SANITY IN LEGISLATION ON ANIMAL EXPERIMENTATION (WITH SPECIAL REFERENCE TO THE DOG).

By

MURRAY GALT MOTTER, M. D.

Formerly Professor of Physiology, Georgetown University Medical School.

No scientist worthy of the name would for a moment justify or tolerate cruelty (the infliction of unnecessary pain), first, because his primary objective is the enlightenment of ignorance and the relief of distress; secondly, because the infliction of unnecessary pain defeats both the method and the object of his investigation. "It is the right of experiment and not the right to inflict pain for which plea is offered. Pain is an irrelevant factor which time and skill are in process of eliminating altogether from surgical operating and animal experimentation."

A dark and ancient blot on the escutcheon of medical art has been its empiricism, and empiricism today is synonymous with quackery and charlatanism. The experience of the ancient empirics, methodists, and dogmatists was had in an atmosphere thick with the fog of prejudice and ignorance, which prohibited the profanation even of the cadaver by the scalpel of the anatomist. The physician of today must study not merely dead tissue, but living organisms, and as from the dawn of creation the lower forms of life have contributed to the welfare of the higher, so must man ever draw upon the lower animals for the means of his life, health, and knowledge. Only through the medium of experimental research may medicine be raised from the realm of empiricism to that of exact science.

Salus populi, suprema lex. If by law the method and means are prohibited by which the health of the people can alone be secured and promoted, not alone will the people suffer, but the very raison d'etre of the guardians of the people's health will be removed and their incentive killed. Why establish a Public Health Service, empower it under the law to "study and investigate the diseases of man and conditions influencing the propagation and spread thereof," endow it with huge funds for that purpose, and then by subsequent legislation proscribe the recognized means and methods of pursuing such study and investigation?

Why should the burden of proof in this argument be thrust upon the medical profession, so small a proportion of the community at large, when it is the safety of the latter which is at stake? Recent events and current costs have shown that greater ease and higher emoluments

are to be found without than within the medical profession. Why should the doctor worry? When, by reason of his special training and experience, this work is assigned to the biologist, why question not only his judgment but even his motives in the selection of the instrumentalities through which he shall render this service to humanity? Does the patient or his family dictate to the surgeon what anesthetics or antiseptics he shall use, how he shall place his ligatures, what instruments and procedures are necessary in a capital operation—because, forsooth, these questions have all been settled by animal experimentation?

As was well said in the hearings before the British Parliament on the dogs protection bill (happily defeated the past summer): "This bill is a test case—not for the dog nor the medical profession, but for the intelligence of the House of Commons." And, again, "The passage of this bill must involve an unnecessary continuation of pain, disease, and death among men, women, and children," to say nothing of dogs. But there is still another, reflex influence of such legislation, which must revert to the detriment of the public; if the spirit of research be thus ruthlessly stifled and killed, the intellectual standards of the medical profession must suffer and, consequently, the power and efficiency of the medical practitioner be impaired.

To come more specifically to the matter in hand: The argument that some animal other than the dog can be used for experimental purposes is wholly unworthy of those who would advance it. If the purpose of antivivisection legislation is the protection of animals, no class distinctions can be admitted, but to be thoroughly consistent these advocates must at once and forever forego all animal foods and become absolute vegitarians. Nay more, should they not at once cease in any way to use any of the lower animals for their own selfish benefit?

This aside, however, the dog can not be replaced by any other animal in the research laboratory for certain kinds of experimental work. Fishes, frogs, and turtles, birds and poultry, mice, rats, guinea pigs and rabbits, goats, sheep, pigs, cows and horses, monkeys and apes, all have their uses, and are used in experimental biology and medicine, but no one of these has so manifested a desire for the companionship and service of man as to live with him under the same roof and partake of the food from his table. Similarity of environment and habit are important and determining factors in comparative biology; moreover, availability, size, and character of tissues must all be taken into consideration in the selection of the proper animal for the experimental purposes.

It is for these reasons that the dog has been an especially fruitful object of experimentation in the study of the functions and disorders of the digestive system. Not every surgeon, such as William Beaumont, has the opportunity of making direct, experimental observation upon a human object, such as Alexis St. Martin; and the difficulties

entailed in bringing the human subject to heel, and keeping him under such control as is essential for accurate results, are sufficiently obvious. Recent investigations as to the causes, nature, and methods of prevention of diabetes, rickets and disorders of the teeth have been made possible through experimental observations on the dog; and the modern wonders of intestinal surgery, without the dog as a medium, would have been impossible.

In the study of the functions and disorders of the heart and circulatory system, the dog has been invaluable and irreplaceable. Save for the aid afforded by our faithful friend and servitor, the dog, no surgeon would venture to suture a stab wound of the heart; and many of our boys, sore wounded on the battle fields "over there," have returned and recovered only by the aid of the dogs used in the development of modern vascular surgery and the technique of blood transfusion. Was this service any more dangerous or less effective, than that rendered by the military dogs, sent through the hail of machine gun fire to ferret out the wounded doughboy in no man's land? Some of the survivors of the latter group have, with universal approval and applause, been decorated "for distinguished service," shall we deprive their survivors of the possibility of similar distinguished service?

In the fevered search for some means of withstanding the hellish Hun assaults with poisonous gas, it was tried out on the goat; but the goat proved immune, and therefore ineffective, and again the dog came to the rescue of man as the sacrificial test object. Goats, pasturing in fields submerged with poisonous gas, cropped their fill unconcerned. Men, sent to ascertain which was at fault, goat or gas, succumbed. The dog was found to be sufficiently susceptible, available, and effective in the experimental researches which enabled us finally to outhun the Hun in his devilish method of modern warfare.

Nor has the dog been, always and solely, the sacrificial victim. Through the study of the dog and its diseases, by exactly the same methods and with exactly the same motives, experimental pharmacology has devised and used the means of curing the dog of a distressing and fatal distemper.

Many dogs have been awarded medals for rescuing human beings from drowning, not a few have lost their lives in the effort, and their memory has been perpetuated in stone and bronze. Let us have a memorial laboratory, erected to the honor and glory of the dogs which shall yield their lives in the rescue of human subjects of dropsy, beings drowned in their own juices.

The problems of cerebral localization were solved, and the operative procedures, which have rescued human victims of brain traumas and tumors and restored them to length of years and functional activity, have been perfected through experimental work on dogs. The antagonism between the blood serum of dogs and the microbic cause of tuberculosis has lead to some interesting and helpful results in the fight

against the great white plague. The deleterious effects of alcohol and narcotics upon the vital economy have been studied on dogs; and, today, the experimental, laboratory dog bids fair to rescue unnumbered children from the torments of tetany.

It is just because the dog is the friend of man, has lived in the same environment and on much the same food, that it is indispensable in the studies which shall lead to the alleviation of many of the ills to which human flesh is heir.

If, as some of our dogophile friends would seem to imply, we are to endow the dog with a soul and higher aspirations for service, while we pay tribute to its eminent faithfulness and service in the past, can one conceive a higher ambition for the superdog of the future than thus to continue in the faithful and necessary service of man, by stalking and balking, the grim monsters of distress, disease, and death?

VIVISECTION IN THE STUDY OF NERVOUS AND MENTAL DISEASES.

By

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The benefits to be obtained by animal experimentation in the study of nervous and mental diseases are not at once so apparent as is the case in other branches of medical practice. The first impression is that the mental processes of animals, even the highest, and men are so radically different that nothing can be learned of the latter by studying the former. A few minutes serious consideration will serve, however, to dispel this impression.

In the first place, there is an intimate connection between the central nervous system and the process of thinking. Just how ideas or thoughts are conceived or to just what structures pertain the mental processes, we do not know. We are gradually coming closer to the localization of them, however. We do know in a general way that serious injury to, or disease of, the cerebrum results in mental impairment; we know that autopsies of idiots have shown their brains to be under- or mal-developed.

It is well known in neurology that serious, chronic nervous disorder results in some mental impairment. The man who has had multiple sclerosis, or progressive muscular atrophy, or syringo-myelia for several years is very likely to show defects of his intellectual powers

and in some cases more acute psychotic symptoms. Efforts to correlate the pathology of the nervous disease with the nature of the mental symptoms have not been very successful, largely because these cases, which are comparatively rare in the first place, usually run on to a fatal termination when the central nervous system has been considerably wasted. In other words, at the autopsy we see an end result, with a great deal of degeneration of nervous tissue.

Efforts have been made also to find what connection, if any, exists between lesions in certain parts of the brain in insane persons and the character of the symptoms they show, hallucinations of hearing, delusions of persecution, and so on. These have been futile for approximately the same reasons. The natural thing is, then, to approach the problem from some other angle. For as much suffering as physical disease has caused mankind, there is little doubt that mental disease has caused more.

Lately a great deal of light has been thrown on problems of human psychology by the study of animals, especially of the monkey tribe. It has been found that comparative psychology has its place in science, as well as comparative anatomy and physiology. The study is only yet in its infancy, but it is easy to see what a field it opens up. The study of normal animals having resulted in certain definite knowledge about their behavior and emotions, it would be possible to produce experimentally lesions of certain parts of the central nervous system and determine what modifications of the mental reactions then occur.

Already work has been done in the study of nervous diseases. Formerly a stroke producing paralysis of one-half of the body was considered practically irrecoverable. A certain amount of improvement took place in the first six months, say, after the stroke, and very little, if any, thereafter. This was about as much as was known of the subject when investigators started in experimenting on monkeys. It was found that removal of a part of the brain produced a paralysis on the opposite side of the body, which spontaneously improved somewhat; it was then discovered that by means of reeducational exercises the sound half of the brain could be made to function for the injured half and the paralyzed half of the body restored to its normal function. This knowledge was found to be incalculable benefit during the Great War when injuries to the brain tissue from projectiles were not at all uncommon.

In addition, much valuable knowledge about the function of various parts of the brain was obtained from monkeys. It was found, for example, by stimulating a certain spot of the brain in a monkey under an anaesthetic that the right hand would twitch, another spot the left hand, and so on. The particular advantage of this knowledge is in localizing

cerebral diseases such as brain tumors. These have always presented difficult problems to the general physician and even to the neurologist. It is well known that a beginning tumor in certain regions can be easily and safely removed, but becomes inoperable if allowed to grow and usually results fatally. Too much knowledge then cannot be obtained about the effects of pressure in different regions of the brain.

We are beginning then to approach the problems of nervous and mental disease with more prospects of learning something about this obscure region than we have ever had. On the one hand, we have the interpretative pyschiatry, including psycho-analysis, whereby we seek to analyze mental processes and find out how they become distorted, and on the other hand we have animal experimentation whereby we may find out exactly what occurs in the nervous system to produce the physical signs of paralysis, tremors, convulsions, etc., and what injuries to the brain, and in what region, will produce mental impairment.